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THE OPTICS OF PHOTOGRAPHY.

Handbuch der Photographie: II Theil: Das Licht im Dienste der Photographie und die neuesten Fortschritte der photographischen Optik. By Prof. Dr. H. W. Vogel. (Berlin: Robert Oppenheim (Gustav Schmidt), 1894.)

THIS second part of Dr. Vogel's well-known handbook is the fourth edition, completely revised and enlarged, as we are informed on the title-page. With the index it runs to 367 pages, and is embellished with numerous figures and a coloured frontispiece illustrating the Vogel-Kurtz process of printing in three superposed colours. The result is very satisfactory, and the grapes, pineapple, lemon, and other fruit appear very natural. There should be a promising future for this chromolithographic development of photography, which, it may perhaps be not altogether unnecessary to state, has nothing to do with the great question of direct photography in natural colours.

It is difficult within reasonable compass to give an adequate notion of the wide range of subjects dealt with in the present work. Everything likely to be of use to the scientific and practical photographer is treated of with more or less completeness. While the first part, which we noticed in these columns some years ago (vol. xliii. p. 3), deals with the chemical aspect of the subject, the instalment under consideration is devoted to the optical aspect, using the term optical in the wide sense of comprising the general nature of light regarded as a chemically active natural force. The optics of photographic lenses finds a place in the present part in the form of an appendix covering some ninety odd pages, and copiously illustrated. The appendix covers all that is usually comprised in this country under the term "photographic optics," and it is treated in a manner intended to be generally understandable; the actual German heading is, "Gemeinverständliche Darstellung der Grundzüge der photographischen Optik." The seven chapters forming the appendix deal with the methods of forming images, lenticular refraction, faults of lenses, intensity of illumination and "field," differences in photographic objectives, the stereoscope, panorama apparatus, and the principles of photographic surveying. The seventh chapter is of especial interest because it deals with the latest advances in the construction of photographic objectives, and comprises, among other things, a description of the teleobjectives of Miethe, Steinheil, and Zeiss. The remarkable efficacy of this new addition to the resources of the photographer is shown by two pairs of reproductions of photographs of views taken from the same spot, one with an ordinary, and the other with the teleobjective.

We have called attention to the appendix first, not because we desire to follow the practice of certain readers of fiction who form an opinion as to whether a book is worth reading by beginning at the last chapter, but because it treats of that portion of the subject which we here are too apt to regard as comprising the whole of photographic optics. The main portion of the work under notice treats of subjects quite distinct from that of the properties and construction of lenses, but which are of equal importance in modern photography. This portion of the book consists of thirty-one chapters extending over 266 pages. A brief analysis of the contents will give the reader a general idea of the scope:—Intensity of light and Lambert's law, measurement of intensity, the optical photometer, standards of light, Weber's definitions, the brightness of transmitted and reflected light for different substances, the photographic photometer or sensitometer, photographic standards of light, Miethe and Michalke's law of photographic reciprocity in developed films, dependence of the transparency of the negative on the period of exposure and on the intensity of the illumination, the chemical intensity of day and sunlight (Bunsen and Roscoe), intensity under limited sky illumination, continuing rays and the effects of previous and subsequent illumination, sources of artificial light for photography, reflection, halation, composition of light and photography of coloured objects, chemical action and absorption, properties of optical sensitisers, action of colouring matters on collodion and gelatine plates, shifting of the maxima of photographic activity (Wiedemann's law), relations between sensitiveness to light and optical sensitisers of the eosin series, other optical sensitisers, action of simple and mixed optical sensitisers on sensitiveness, ray filters (*i.e.* colour screens), instruments for the study of the colour sensitiveness of photographic films (*i.e.* spectrographs), testing of colouring matters and films for colour sensitiveness, reproduction of natural colours by multiple photography, direct photography in natural colours, colour perception and complementary colours, observations on the colour transparency of the atmosphere.

To those who are acquainted with photography as a science,[1] the headings to the various chapters will give sufficient indication of their contents. There are, however, many topics of importance hidden away, as it were, among the mass of information contained in the book, and to some of these we may direct the attention of the general reader who, without being an expert, may wish to ascertain the present state of knowledge with regard to such subjects as are of physical or chemical interest beyond their immediate application to photography. Thus, with regard to the standards of light we learn that preference is given over all others to the amyl acetate lamp of Hefner-Alteneck—a preference which many in this country will no doubt be prepared to dispute. Then, again, with respect to the amount of light reflected from various surfaces (chapter v.), some useful measurements are given, partly from the author's observations and partly from determinations by Kirschmann. The photographic efficiency of various sources of light (chapter vii.) is also a subject of general interest, apart from its practical bearing. The enormous chemical activity of the light of burning magnesium is well known, but the results stated quantitatively will be startling to many. According to Eder (to quote a few examples) the light in a

[1] We are much in want of some term to distinguish the scientific student of photography from the ordinary camera-carrying picture-taker. The relationship between the two classes is much about the same as that between the bird and animal stuffer and the "naturalist" whose designation he adopts. The designation "luciscribe" is quite as applicable to those who practise the art only, but it does not seem sufficiently harmonious to suggest its adoption.

well-lighted studio (expressed in normal candles) is 50,000–100,000; direct sunlight (October), 450,000; electric arc light of 8000 candle visual intensity, 100,000–300,000; flash light with four grammes magnesium powder, potassium chlorate and perchlorate, 10,000,000.[1]

The chapter on sensitometers is particularly good, and the critical discussion of the various systems in vogue will be found most useful. It is true that the author urges the advantages of his own "tubular photometer," but this does not prevent his doing justice to other forms. The discussion of the so-called law of photographic reciprocity according to Miethe and Michalke (chapters viii. and ix.) comes most opportunely at the present time. The relationship between the density of the silver deposit formed on development and the time of exposure, intensity and quality of light, &c., is a subject which has given rise to a great amount of discussion in this country lately. Strange to say, however, Dr. Vogel gives no reference to the work of Abney, Hurter and Driffield, and others who have taken part in the recent discussions. This is certainly an omission. It appears that Dr. Miethe undertook to investigate the accuracy of the law of reciprocity in order to ascertain whether photography could be applied to the measurement of the brightness of the stars. [*A priori*, one would have thought that the ordinary photographic plate would be inapplicable to this purpose because the photographic efficiency is dependent on the *quality* of the light emitted by a star, and this does not necessarily coincide with visual intensity.] Among other points brought out by his investigation is the fact that for very feeble illumination the law in question does not hold good, but when the light is about four times the intensity necessary to produce a visible result (on development) the relationship is true up to 1000 times this intensity. Other deviations from the law are discussed by Michalke in the paper which Dr. Vogel partly reprints, but enough has been said to indicate the importance of these two chapters.

The portions of the work to which those who have followed the recent developments of photography will naturally turn with great interest, are those dealing with the action of special sensitisers, a subject which will always be identified with Dr. Vogel as the discoverer to whom we are indebted for this advancement. The greater portion of the volume—viz. chapters xvi. to xxvii. inclusive—are devoted to this and related subjects. In connection with the sensitiveness of the silver haloids to the colours of the spectrum, the author brings out one point very clearly, and that is the futility of using the sun as a source of light in such experiments. It appears that the photographic transparency of the atmosphere is subject to such very great fluctuations, that the maxima of chemical activity are apt to be considerably shifted from day to day, so that concordant spectrum prints must not be expected from the solar spectrum in cases where accuracy is required. The action of organic colouring matters as special sensitisers receives very full treatment, and all the recent investigations on this subject are brought together. Of these the experiments of Dr. E. Vogel on the colour sensitiveness of the eosin colouring matters by themselves (chap. xx.), and on the special sensitising action of the *pure* colouring matters of this group on gelatino-bromide emulsion films (chap. xxii.), are of considerable importance. It appears now that the fugitive character of these colouring matters is due to photochemical reduction, and not oxidation (pp. 163–164); but the evidence on this point does not appear to the writer to be quite conclusive. It is shown, further, that the best of these colouring matters as special sensitisers are those which are by themselves the most sensitive to light—viz. tetraiodo- and diiodo-fluoresceïn—that the silver salts are better than the alkaline salts for this purpose, and that the sensitising power increases as the fluorescent power diminishes.

Other organic colouring matters are treated of in connection with this same photographic property, and the details, as given in the book, will be found well worthy of study. We may here call attention to the interesting work of Wollheim (chap. xxiii.) on chlorophyll, from which it appears that the efficient special sensitiser in the case of this substance is the phyllocyanin. The uncertain action of chlorophyll is well accounted for by these researches. Among recent work on the action of organic colouring matters, the author gives an account, almost verbatim, of that published by Mr. J. Acworth in 1890. This writer has made a detailed study of all the most efficient special sensitisers, and, as a general conclusion, confirms the view that the maxima of absorption and chemical activity do not absolutely coincide, but that a displacement occurs in accordance with a law which has been developed theoretically by E. Wiedemann. Figures of some of the absorption and photographed spectra are given (p. 192), and a plate giving Acworth's curves for the various colouring matters.

We might have dwelt upon many other topics discussed in the book; enough has been said, however, to show that photographic literature has been enriched by a work which will take rank among the classics in this subject. If, in concluding this notice, some defects are pointed out, it is not that the writer feels bound as a critic to find fault with something, but because in a work of high standard, such as this, small faults obtrude themselves and become great by contrast. In the first place, then, the author does not give sufficient recognition to work done in this country. One such omission has already been pointed out. Similarly the work of Abney on colour measurement, which is so closely related to the subject-matter of chapter xxx., is not referred to. Although J. J. Acworth's experiments on orthochromatic photography are given *in extenso* (because originally published in *Wiedemann's Annalen?*), the prior work of C. H. Bothamley is not described. In connection with the theory of direct photography in colours by the method of interference, Zencker alone is mentioned, and all reference to Lord Rayleigh's work on this subject omitted. But still more serious is the introduction of polemical matter into the work—in some parts to such an extent as to become an actual disfigurement. The whole of chapter xvii., on the history of the discovery of the action of special sensitisers, might very well have been omitted; what is the use of reprinting a series of polemical papers published twenty years ago, especially when one of the combatants (Schultz-Sellack) is dead?

[1] These numbers are referred to the *photographic*, not *visual* intensity of the standard candle.

Then, again, the passage of arms between the author and Dr. Neuhaus in this same chapter, and Herr Hruza (chapter xxviii.) and, above all, Mr. Ives (pp. 239-240), is conducted in a manner that in this country would be regarded as very bad form. Perhaps German notions of scientific literary taste differ from ours, but the writer of this notice has never yet come across a German work professing to be a scientific text-book, in which such bad taste is shown as in the introduction of the personalities which are here indulged in.[1] Discounting these imperfections, Dr. Vogel is to be congratulated on this second instalment of his book; it will be found valuable as a compilation, and still more valuable as embodying much original work. No scientific student of the subject can dispense with it, and beyond the domain of pure photography the chemist and physicist will find much in its pages worthy of consideration. R. MELDOLA.

THE MEASUREMENT OF ELECTRICAL RESISTANCE.

A Treatise on the Measurement of Electrical Resistance. By William Arthur Price, M.A., A.M.I.C.E. (Oxford: Clarendon Press, 1894.)

OF all electrical measurements probably that of measuring a resistance is the most important, since the resistance of many bodies is a permanent quality, and resistances can be compared by means of apparatus of comparatively simple construction, while the results obtained are much more accurate than in the case of any other electrical measurement. Most books on practical electricity contain more or less complete descriptions of the methods generally employed in the measurement of resistance, and in some cases give what may be called "diagrammatic" descriptions of the construction of the different forms of apparatus employed. The work under consideration, however, goes much further, for in it the mechanical details of the construction of the apparatus are described in a manner which shows that the author is practically acquainted with his subject.

The book may be roughly divided into two parts: in the first of these the materials used in the construction of resistances and the different methods of winding and mounting resistance coils are fully dealt with; while the second part contains full descriptions of the methods ordinarily employed in the measurement of resistances, both high and low.

The first chapter is introductory, and contains a definition of the term resistance, while the conditions to be fulfilled by a material suitable for the construction of standard resistances are shortly discussed. The properties of the different alloys employed in the construction of resistances are fully dealt with in the second chapter.

After referring to the artificial "ageing" of manganine wire, and to the extremely small value of the thermo-electric force between this alloy and copper, the author says that the electrical properties of this material seem to be quite permanent. This opinion, however, is at variance with the experience of most people who have tested this alloy, and it would be of interest to know whether any satisfactory experiments have been made to settle this point. Although it may be important in many commercial operations, where accuracy is not so much aimed at as simplicity and freedom from troublesome corrections, to make resistances of alloys having a low temperature coefficient, yet in any experiment where accuracy is necessary it is much more important to have a constant and linear function for the temperature correction than to have an extremely small but variable and uncertain one. A comparison of the curves for the variation of the resistances of the different alloys, which have been reproduced from Profs. Dewar and Fleming's paper, shows at once the fatal objection to manganine. Another objection to this alloy, as at present manufactured, is the extreme variation in physical properties between the different samples supplied.

Two very interesting chapters are devoted to the construction of resistance coil bobbins, and the methods employed for winding the wire. In connection with the question as to the best form to give standard resistance coils in order that the temperature may be accurately known, the author recommends that the coil be enclosed in a thick copper case, with a recess filled with mercury for the insertion of a thermometer, the whole to be covered in with a wooden case, to protect it from dust and draughts, instead of the usual thin case and water-bath. This method of securing a uniform temperature is very satisfactory when no heat is generated within the apparatus, but in the case of a resistance coil and a thermometer placed in a hole filled with mercury in the enclosing case, where the passage of the testing current heats the wire, the thermometer would probably "lag" considerably behind the wire; and the chief effect of the thick case would be to screen the thermometer from the changes in temperature of the wire.

The heat developed in a coil, and the rate at which the temperature rises, are shortly considered, data being given for calculating these quantities. It would be a great improvement, however, if in a subsequent edition a table were given showing at a glance the maximum current which can with safety be passed through the different coils of resistance boxes wound with the sizes of wire ordinarily used. Whether it would be possible to indicate this quantity on the boxes of coils as sent out by the makers, is perhaps doubtful; but if it could be done, it might perhaps stay the hand of the too venturesome student, who is continually trying to ruin any resistance boxes he may be using by passing an excessive current.

While the chapter on the Post Office and Dial forms of Wheatstone's Bridge is very complete, and contains a very useful table of the best resistances to be used in the ratio arms of a Post Office Bridge, that on the Slide Wire Bridge can hardly be said to be so. The only form of Slide Wire Bridge at all fully described and illustrated is of the ordinary design to be found in elementary physical laboratories. Although this is sufficient for teaching purposes, it is hardly suitable

[1] Out of consideration for those concerned, I refrain from giving specimens of the paragraphs complained of. Can it be that the style of discussion is incidental to the subject? Similar lucubrations are sometimes to be seen embellishing (?) the pages of photographic journals. In passing the above strictures it is to be understood that the question of the author or his antagonists being right or wrong is not raised: it is the style which is objected to - the transference of personal polemics from journals in which they might possibly be tolerated, to the pages of a text-book in which they are intolerable.

for very accurate work. No mention, either, is made of any form of switch-board, such as that designed by Prof. S. P. Thompson, for the interchange of the coils when using Carey Foster's method of comparing resistances. A good description, accompanied by several excellent diagrams, is, however, given of Kelvin and Varley's slide, and of Kelvin's apparatus for the comparison of low resistances.

The remaining chapters are devoted to the measurement of high resistances, of batteries, and of electrolytes. There are six appendices, in which the mathematical theory of the Wheatstone's Bridge, Lord Kelvin's method of measuring low resistances, and Manse's method of measuring the resistance of a battery are given, together with discussions on the E.M.F. of contact at the junctions of a metre bridge, on the discharge of a condenser through a high resistance, and on the electrostatic analogue of a Wheatstone's Bridge.

The work would have been more useful if its scope had been enlarged, and if it had contained a detailed description of some complete set of instruments used in the comparison of standard resistances, such as are used by the British Association Committee on Electrical Standards at the Cavendish Laboratory. Nevertheless, it is a good book, written by one who is practically engaged in the manufacture and testing of these instruments, and who, not content with rules of thumb, gives the reason for each point involved in the design and construction.

There is no doubt the book will be found of great use in every laboratory and testing-room, and is, as the advertisers of patents are wont to say, "calculated to fill a long felt want." W. W.

AN ASTRONOMICAL ROMANCE.

A Journey in Other Worlds; a Romance of the Future. By John Jacob Astor. With ten Illustrations. Pp. 476. (London: Longmans, Green, and Co., 1894.)

SINCE Jules Verne wrote his "Journey from the Earth to the Moon," many writers have tried their hands at similar productions, but none have excelled their prototype. A good grasp of the principles of science, a vivid imagination, and a brilliant descriptive power, are essential faculties in the man who proposes to give the public a view of the future as seen through his prophetic eye. We do not think the author is blessed with a bountiful share of these qualifications; nevertheless, he has been able to bring forth a book in which instruction and entertainment are happily combined.

Looking forward to the epoch A.D. 2000, the author saw that many things had come to pass which are undreamt of in the philosophy of this enlightened century. The incidents of the story are centred round a scheme for changing the obliquity of the ecliptic, and a machine in which trips are taken to Jupiter and Saturn. It is a source of regret to many people, and especially to those who are doomed to linger in an erratic climate like ours, that the earth's axis is not perpendicular to the ecliptic. If such a condition of things existed at the present time, it could truly be said, "Blessed are they that inherit the earth." Every latitude would have its own almost uniform temperature all the year round, and the slight eccentricity of the earth's orbit would be sufficient to awaken recollections of the succession of the seasons. Life would indeed then be one perpetual spring.

The idea of decreasing the obliquity of the ecliptic is only an incidental part of Mr. Astor's story. The greater part of the book is taken up by an account of a journey to Jupiter and Saturn. But, before passing to this section, we must point out that a certain looseness of expression is manifest in the previous one. The project of changing the obliquity is constantly referred to as one of "straightening the terrestrial axis." The impression that the general reader will obtain from such an expression is that the earth's axis is only "straight" when it stands bolt upright, as it were, in the plane in which our globe revolves round the sun. How the author came to use the word "straight" in the sense which he does, passes our comprehension. Another and really less important matter, is that the earth's axis is said to be "inclined to the ecliptic about 23½ degrees." To be correct, the author should have said that the inclination to the ecliptic is 66½°, and that the angle between the axis and a perpendicular to the ecliptic is 23½°.

We come now to the flying machine. Jules Verne utilised known powers when he sent his imaginary car from the earth to our dreary satellite. Others who have followed in his wake have had to hypothecate their forces. *Apergy* is the force employed by Mr. Astor's characters. Similarly electrified bodies repel one another, argues he, then why may not matter exist in such a condition that gravitational attraction becomes apergetical repulsion? Given such a source of perpetual energy under control, and, heigh presto, away we can go into the realms of space, with concentrated extracts for food, and liquid oxygen for air supply. Three individuals undertook this kind of voyage in the year A.D. 2000; at least so the story goes. One is a learned bore who discourses sapiently on all and sundry circumstances of the journey. For instance, the information he hurls at his companions as Jupiter's largest satellite, Ganymede, is passed, is as follows. "This was discovered by Galileo in 1610. It is three thousand four hundred and eighty miles in diameter, while our moon is but two thousand one hundred and sixty, revolves at a distance of six hundred and seventy-eight thousand three hundred miles from Jupiter, completes its revolution in seven days and four hours, and has a specific gravity of 1·87."

This individual is brimful of knowledge which wells up at every opportunity, and, after a time, becomes very oppressive. His two companions, on the other hand, though assigned acute understandings and good educations by the author, listen in silence to these tiresome lectures on the most elementary facts of astronomy—an incongruity which is a very weak point in the story. Furthermore, the obtrusive dispenser of scientific scraps is much behind his time, for his astronomical knowledge does not go beyond that of the present day. If Mr. Astor were thoroughly conversant with astronomical investigations, he could have made his professor a much more interesting person. As it is, the man pours forth his spirit in and out of season, and is just the sort of individual that the majority of people are anxious to avoid.

We will pass over the little incidents of the journey to Jupiter. Suffice it to say that Mars and his moons were observed, that a few asteroids were met and a comet penetrated, and eventually the Callisto—that was the name of the car—was landed on a hard part of the planet's surface. Jupiter was found to be in the Palæozoic period; and a smattering of geological knowledge has enabled the author to conjure up multitudes of "extinct monsters," which quite eclipse those in Mr. Hutchinson's book.

Having passed through Saturn's ring, and seen for themselves that it was composed of meteoritic particles, the party arrived safely on the planet. Our belted brother was found to be an abode of spirits, upon the characteristics of which we are not competent to express an opinion. The height of the ludicrous is reached at a dinner given to the travellers by one of these airy nothings, who, we are gravely told, "took only a slice of meat and a glass of claret." The idea of a diaphanous bishop consuming meat and claret is very rich.

A word or two on the general character of the book may not be out of place. The author rightly terms his production a romance—that is, a story hung upon seeming impossibilities. There is no plot, and the characters are merely mechanical puppets used to expound didactic ideas, so the book cannot be called a novel. It is, in fact, little more than a reading-book suitable for beginners in astronomy. We doubt whether many people will read it through without skipping the prosy parts, but they who conscientiously do so will undoubtedly acquire a certain amount of more or less useful knowledge. The author is usually accurate in his astronomy; and this, considering that writers of romances generally play fast and loose with astronomical phenomena, is saying a good deal. We commend the book to readers who like instructive tales.

R. A. GREGORY.

OUR BOOK SHELF.

Ueber die geometrischen Eigenschaften homogener starrer Structuren und ihre Anwendung auf Krystalle. Von W. Barlow. (Leipzig: Engelmann, 1894.)

THIS paper, which was recently published in the twenty-third volume of Groth's *Zeitschrift f. Krystallographie*, is an interesting contribution to the theory of crystal structure.

Mr. Barlow investigates the nature of a homogeneous structure, by which he means an arrangement of any material of constant form which is uniformly repeated throughout its whole extent. To every point in such a structure correspond other points homologous with it, and these must constitute one of the sixty-five regular assemblages of points as defined by Sohncke in his well-known treatise on crystal-structure. But the symmetry of the structure is not always identical with that of the assemblage of points derived from it, and it is sometimes necessary to extend the latter by a geometrical process of reflection or inversion in order to arrive at the symmetry of the structure. This process results in the addition of 164 possible homogeneous structures to the sixty-five already established. Incidentally it is shown that the assemblages of Sohncke are not in reality independent, but can all be regarded as compounded of one or other of ten assemblages belonging to the least symmetrical types in the various systems of crystallography. Fedorow and Schönflies have independently advanced a new theory, and agree in the result that there are 230 possible types of homogeneous structure. Since their methods are based upon Sohncke's definition extended by the principle of reflection or inversion, Mr. Barlow's investigation should lead to the same result. Now he finds 229 types, and expressly states that he is unable to account for a certain one of Fedorow's structures, so that his work is an absolute confirmation of the general accuracy of their calculations.

When this trifling question of 229 or 230 is settled, the problem of homogeneous structures, which was approached by Hauy 100 years ago, may be regarded as completely solved *from the purely geometrical point of view*.

Mr. Barlow's analysis of Sohncke's assemblages, and his laborious synthesis of the 164 new types, make the relations between the old and the new theory intelligible, and enable the reader to form a mental picture of all these complicated groupings: a task which is by no means easy from the writings of Fedorow and Schönflies without the aid of Mr. Barlow's tables.

H. A. M.

Theoretical Mechanics.—Solids. By Arthur Thornton M.A. Longmans' Advanced Science Manuals. (London: Longmans, Green, and Co., 1894.)

THE manuals published in this series are written specially to meet the requirements of the advanced stage of science subjects, and the present book will be found a very worthy addition. It is not surprising to hear, as the author tells us in the preface, that in preparing this work he was confronted by the syllabus of this department. The range which these 400 odd pages then cover, can on this account be at once gathered; and it can safely be stated that the book includes all that is generally necessary for any school course. The order in which the subject has been treated is first kinematics, in which the geometrical science of motion is dealt with, then statics, and finally kinetics, in which force is treated in its relation to motion. In each part the author feels himself by no means bound up as regards the choice of proofs and definitions; and he places before the reader, in a well-arranged series of paragraphs, all the theorems and problems, illustrating them when necessary with clear figures. The real essence of the subject, that is, the "book-work," has had special attention devoted to it, and each chapter contains a special number of problems to be deduced directly from it. Stress has been laid, too, on the importance of solving problems from first principles, and not from a direct substitution in formulæ. Formulæ can easily slip the memory, if not totally, then partially, and it is for this reason that numerous methods and samples of solution have been given.

Examples of all kinds, and especially those introducing great diversity of style, are scattered throughout the work, some being original, while others are obtained from numerous well-known sources. A useful appendix, containing a brief summary of trigonometrical formulæ, and a short index, brings the book to a conclusion. For the convenience of those who are preparing the subject for special examinations, a short list is given of the portions which may be omitted.

The Earth: an Introduction to the Study of Inorganic Nature. By Evan W. Small, M.A. University Extension Series. (London: Methuen and Co., 1894.)

IN this very acceptable addition to the well-known University Extension Series, we have a set of chapters which are not intended to form a text-book on physiography, but to serve as a book containing a certain amount of accurate and definite knowledge for the general reader. Such being the case, the author has not dealt fully with any of the various branches, but has treated, in a sketchy manner, some of the more striking phenomena of the earth. The earth as a planet is first referred to, then the materials of which it is composed, which include the composition of the lithosphere, of the atmosphere, and of the hydrosphere. Next are discussed the laws of energy, and the past history of the earth as gathered from its present aspects, while the last chapter is devoted to the evolution of the earth, with sections on spectrum analysis, and theories of planetary origin. To anyone wishing to obtain a general survey of this many-sided subject, physiography, these pages should be of great service. As has been said before, the information in many cases is brief, and in some cases too brief for explanatory purposes. This is, however, counterbalanced to some extent by a number of useful references at the end of each chapter. An appendix, which may prove handy to teachers, gives a list of suitable lantern-slides for illustrating the subject-matter.

Songs of the Russian People. Collected in the Governments of Arkhangelsk and Olonetz, by Th. M. Istomin and G. O. Dütsch. (St. Petersburg, 1894.)

The northern provinces of Russia are the parts of the empire where the old popular songs are still kept in the memory of the people in their greatest purity. Elsewhere they are often forgotten, or are altered by the intrusion of modern music, very often of the music-hall type. In 1886 the Russian Geographical Society sent out a small expedition in order to collect the really old popular songs —religious, epic, wedding, and so on—and 119 of them are now published, both words and music, in the above-named collection. The words have been taken down by M. Istomin, and the music by M. Dütsch, who have both had a great deal of previous experience in that sort of work. Several songs of the collection are quite new, but the book's chief value is in the melodies of the epic songs (*byliny*), which now become known for the first time. It had always been supposed that the epic songs had no melodies, and were simply delivered in a sort of monotonous recitative; but it now appears that some of them have their special melodies, grave, most beautiful, and bearing the stamp of great antiquity. A map appended to the book shows the places visited by the expedition.

Visions of the Interior of the Earth, and of Past, Present, and Future Events. By H.R. and M.S.H. the Prince of Mantua and Montferrat. (London: Simpkin, Marshall, and Co., 1894.)

"Shadows to-night have struck more terror to the soul of Richard,
Than can the substances of ten thousand soldiers
Armed in proof, and led by shallow Richmond."

These lines are brought to mind by Prince Mantua's visions, which are calculated to produce a more or less terrifying effect upon the gentle reader. We cannot review the book seriously, for it is merely a record of what the author heard and saw while in a state of trance, and such revelations can hardly add to our knowledge of the earth's interior. Mr. Baxter, and the Society for Psychical Research, may find the volume interesting.

The Complete Poetical Works of Constance Naden. (London: Bickers and Son, 1894.)

In one of his essays, Macaulay, with his usual leaning to antithesis, holds that "as civilisation advances, poetry almost necessarily declines." His opinion was that science and poetry are antagonistic. The late Poet Laureate, however, showed that scientific facts and phenomena could be clothed in language at once poetical and impressive. Miss Constance Naden, who died at the end of 1889, won for herself a high place among poets of science and philosophy, and her admirers include many distinguished votaries of these branches of knowledge. Astronomy, geology, evolutionary ethics, and the nebular theory are a few of the subjects which inspired her to write, and that in a manner which commands admiration. She was a devoted disciple of Mr. Herbert Spencer, and, indeed, was a witness to the truth of his words: "It is not true that the cultivation of science is necessarily unfriendly to the exercise of imagination and the love of the beautiful. On the contrary, science opens up realms of poetry where, to the unscientific, all is a blank."

LETTERS TO THE EDITOR.

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Some New Facts with regard to "Bennettites."

The remarkable state of preservation of many Palæozoic plants, and some few Mesozoic forms, has raised palæobotany to a position of considerable importance in certain fields of botanical investigation. Endless synonyms, and specific determinations of more than doubtful value, have not unnaturally prejudiced botanists against the study of plant fossils. The scientific treatment of the mineralised tissues of extinct forms has, however, been productive of exceedingly important data towards the better understanding of the lines of plant evolution. Synthetic types and intermediate forms of plant structure are already fairly abundant, and the various suggestive facts revealed by a study of their remains are gradually assuming a more definite shape.

The genus *Bennettites* is an example of special interest among ancient plant types. This name was introduced by Mr. Carruthers in his important monograph of 1868, on the fossil Cycadean stems from the Secondary rocks of Britain.[1] The excellent preservation of the species *B. Gibsonianus* enabled this observer to give a detailed account of certain reproductive organs, which were embedded in the armour of the persistent petiole bases enclosing the plant stem. The affinities of this species have since been presented in a somewhat different light by Solms-Laubach,[2] and he is led to the conclusion that the *Cycadeæ* are the nearest known allies of the *Bennettiteæ.* There are, however, important differences between the two groups which preclude the idea that one has been directly derived from the other. The Marquis of Saporta and various other writers have contributed to the literature of *Bennettites,* and the speculations propounded as to its true position have been numerous enough.

We are indebted to the careful researches of Prof. Lignier, of Caen, for some recent additions to our knowledge of this genus, and his exhaustive monograph carries us a step further towards the solution of the Bennettites problem.[3] The specimen which forms the subject of Lignier's work was found by Morière, in 1865, in the Oxfordian beds of Vaches-Noires; two years later the fossil was described by its discoverer as part of a true Cycadean plant. In 1881, Saporta and Marion referred this Oxfordian fruit to the genus *Williamsonia;* and subsequent writers have assigned the fossil to various positions in the plant kingdom.

The specimen of *Bennettites Morierei* (Sap. and Mar.) described by Lignier is ovoid in form, and has a length of 55 mm., with a breadth of 35 mm. At the base a fractured surface reveals the existence of a slightly convex receptacle, from which is given off a compact cluster of long peduncles, each of which bears at its apex an oval seed. The seed-bearing peduncles are surrounded by several involucral bracts closely applied to

1 *Trans. Linn. Soc.* vol. xxvi., 1870, p. 663.

2 *Annals Botany,* vol. v., 1890-91, p. 419 (translation from *Bot. Zeit.,* 1890.)

3 "Végétaux fossiles de Normandie. Structure et affinités du *Bennettites Morierei* (Sap. et Mar.)." With six plates. Octave Lignier. (*Mém. Soc. Linn. Normandie,* vol. xviii., 1894.)

the surface of the fruit. Unfortunately the fruit is isolated, and affords no clue as to the nature of the organ to which it was originally attached. Numerous thin lamellæ occur in association with the seminiferous peduncles; to these Lignier has applied the term interseminal scales. The seeds are arranged side by side close to the upper surface of the mass of peduncles and interseminal scales; the latter pass between and beyond the seeds, and their swollen distal ends form a protective covering to the blunt hemispherical apex of the fruit. In surface view, the upper part of the specimen appears to be made up of a large number of small projecting areas with polygonal bases and rounded summits. Here and there the projections arrange themselves in the form of rosettes round a small central cavity, marking the position of a seed.

Involucral Bracts.—Some important facts have been brought to light as the result of a detailed histological examination of these structures by means of a series of transverse sections. In section each bract has the form of an isosceles triangle with the base directed towards the surface of the fruit. The excellent preservation of the tissues affords indisputable evidence of the existence of stomata and numerous lamellar epidermal outgrowths, similar to certain structures described by Carruthers in *B. Gibsonianus*. The most interesting part, perhaps, of Lignier's account of the bract tissue, is the inference he draws from an examination of the course and structure of the several vascular strands traversing each bract. It would seem that the vascular bundles are far from their termination, and that the involucral bracts as shown in the specimen are merely the petiolar portions of leaf-structures, of which the pinnate or flabellate laminæ have not been preserved. Immediately underneath one of the scaly hairs of an involucral bract a section has cut through what is apparently a lenticel; in this case, suggests Lignier, lenticel development has probably taken place as the result of irritation consequent on the fall or decay of a hair.

Seed-bearing Peduncles.—The main portion of the fruit itself is made up of well-developed peduncles having a length of 30–45 mm., and a diameter of 1·5 mm. Each peduncle consists of fundamental tissue traversed by a single axial bundle, and surrounding the whole there is a very characteristic epidermal layer, which is gradually replaced towards the upper part of the fruit by a "tubular envelope" of variable thickness. This change is probably the result of the elongation of the peduncles, and of the epidermal cells which increased in length without undergoing transverse division, and thus became transformed into tubular elements. A similar alteration of epidermal cells occurs in *B. Gibsonianus*, but in that species its true nature was apparently not recognised by Carruthers and Solms-Laubach.

Seeds.—Each peduncle terminates directly in an orthotropous seed with a single integument; the seeds are elliptical below, and assume a tetragonal or pentagonal form towards their apices. In the neighbourhood of the seeds, the tubular envelope of the peduncles is reduced in size, and becomes differentiated into a small tubular, and a folded layer of cells. The former is prolonged to the apex of the seed; the latter retains its special character in the lower half, but towards the upper half of the seed its cells become radially elongated, and give place to a tissue described as the "assise rayonnante." Passing up to the micropylar canal the two layers undergo a further modification; the tubular envelope has now assumed the *rôle* of an ordinary epidermis, and the "assise rayonnante" passes into a simple sub-epidermal layer of cells. The inner face of the micropyle consists of narrow and radially elongated elements, which become isodiametric as we pass down to the pollen-chamber. The fundamental tissue of the seed-coat is divided into an external fleshy and an internal fibrous portion. In describing the cells of the fleshy part of the integument, Lignier points out that the thin cell walls show here and there numerous fine pits, and the cell cavity contains a dark substance which may possibly represent the remains of protoplasmic and other cell contents. In some cases the contracted protoplasm (*sic*) shows slender prolongations which appear to correspond to the pits in the cell wall; these are interpreted as strands which originally traversed the cellulose walls, and connected cell with cell. It is perhaps questionable how far the tissues of fossil plants will stand the strain of the minute descriptions which characterise the work of some French writers; but if protoplasmic continuity can be thus partially demonstrated in a fossil seed, it suggests possibilities beyond the wildest dreams of palæobotanical histologists! The greater part of the nucellus is occupied by a large embryo with two cotyledons. On the whole, the general disposition of the peduncles and seeds is the same as in *B. Gibsonianus*, but various differences in detail sufficiently establish a specific difference.

Interseminal Scales.—These may be compared to the scales in a pine cone; they are associated with the seminiferous peduncles, but extend beyond them, and form a continuous protective layer at the exposed surface of the fruit. External to the interseminal scales there are the so-called superficial scales, which have a fairly definite structure, and are not to be confounded with the external involucral bracts.

The above imperfect *résumé* conveys but a poor idea of the thorough and careful treatment of the fossil at the hands of Prof. Lignier.

In his concluding remarks as to the nature of *B. Morierei*, the author of the monograph expresses himself somewhat as follows:—Regarding the supporting trunk as an axis of the first order, the fruit-bearing axis is of the second order, and has its apex contracted in the form of a convex receptacle; the leaves below the receptacle are transformed into involucral bracts, the leaves inserted on the receptacle itself have become interseminal scales, and the seed-bearing peduncles are fertile leaves belonging to unileaved shoots of the third order.

The inflorescence of *Bennettites* is clearly distinguished from that of the Cycads in the following points:—(1) Ovules are terminal and erect; (2) each fertile bud is of a higher order and much reduced; (3) the inflorescence is compound, formed by the grouping together of several fertile shoots, with a supporting branch and its leaves, &c. "The *Bennettiteæ* are therefore posterior to the *Cycadeæ*, at least as regards the reproductive structures."

On the other hand, the inflorescence of *Bennettites* presents many points of agreement with the *Coniferæ*; *e.g.* in its compound nature, small seeds, unileaved fertile shoots with erect ovules, &c. The points of difference between *Bennettites* and the *Coniferæ* include (1) larger number of sterile leaves associated with the single-leaved buds; (2) the position of the fertile shoots, which is not perhaps strictly axillary, &c. Summing up the whole matter, Lignier says:—"I regard the *Bennettiteæ* as a family which has been derived with the Cycads from common ancestors, but not from the Cycads themselves. Of these common ancestors the two families have preserved the form of the trunk, the structure of certain tissues (large pith, gum canals, diploxyloid leaf-traces, and sclerenchymatous mesophyll), the foliar origin of the ovule, &c. But whilst the Cycads have retained a grouping of carpophylls on a single axis, and have acquired special characters, such as the complication of the leaf-trace and the lateral position of the ovules; the *Bennettiteæ* have retained the simple leaf-trace and have acquired a terminal position of the ovules, the reduction of the fertile axes to a single corpophyll, the grouping of these fertile reduced axes, and the modification of the neighbouring leaves as the result of *précurrence sexuelle*.[1] Perhaps the future will bring to light a greater affinity than is at present suspected between the *Bennettiteæ* and certain fossils referred to the *Cordaiteæ*."

A. C. SEWARD.

Science Teaching in St. Mary's Hospital Medical School.

MY attention has just been called to an article in the issue of NATURE of September 20, headed "Science in the Medical Schools." This article professes to demonstrate by means of a table, compiled from lists given in the students' number of the *Lancet*, the extent to which instruction in science subjects not purely medical is provided in the medical schools. According to this table, no instruction is provided in biology or zoology, botany, physics, practical physics, bacteriology, and hygiene, or public health, in this medical school. If you will refer to the prospectus of the medical school, which I forward with this letter, you will find that very complete courses of instruction are given in all those subjects here, and that the instruction includes lectures, classes, demonstrations, and laboratory work in all the subjects.

[1] In explanation of this term Lignier adds:—"Je désigne sous le nom de *précurrence sexuelle* le phénomène par lequel certains organes soit porteurs de la glande sexuée soit voisins de celle-ci et formés antérieurement à elle, sont peu à peu englobés dans l'appareil sexuel à mesure que celui-cise complique dans la généalogie des plantes. La précurrence sexuelle ainsi comprise se rencontre partout dans le règne végétal."

I cannot help thinking, that before publishing such an article, it would have been but in accordance with common accuracy and equity if you had verified the list of subjects taught in this medical school, by reference either to the prospectus or to one of the officials, who would have been pleased to give you all necessary information. The list relating to St. Mary's Medical School, in the number of the *Lancet* from which you prepare your table, teems with inaccuracies and omissions. It is not a list issued with any authority from this school, nor is it submitted for revision or correction to any official of the school. The statement in your article, that "the table does not pretend to be complete," is one that I cordially endorse; but the subsequent statement, that "it will serve to show the kind of science subjects on which lectures are given to medical students," is one that, as regards the teaching at St. Mary's Medical School, is both misleading and untrue.

My colleagues concerned in the management of this school feel with me that such a reference to our science teaching in a paper of such wide circulation as that of NATURE, is calculated to be most damaging to the interests of our medical school, which we have used every endeavour, and spared no expense, to render efficient from the educational point of view. We therefore trust that you will publish this letter in full, and that you will take the earliest opportunity of correcting the erroneous statement in connection with the science teaching here that appears in your issue of September 20 last.

ARTHUR P. LUFF.

[The students' number of the *Lancet* contains lists of the "classes, lecturers, and fees" at the medical schools of Great Britain, for the session 1894–95. We assumed that these lists were fairly complete, and the table referred to by Dr. Luff was prepared from them. It occurred to us that our contemporary may have omitted some courses inadvertently, and this led us to state distinctly that "the table does not pretend to be complete," and, later on, "courses of lectures on bacteriology are advertised to take place at nine medical schools, but it must not be supposed that they are the only schools having facilities for carrying on this work." The table served its purpose of showing the kind of sciences taught in medical schools in addition to the usual professional subjects. It was not intended to be used as a criterion of the efficiency of the schools individually.—ED. NATURE.]

Gohna Lake.

THE notices in NATURE (August 30, p. 428, and September 20, p. 501), on the overflow of the lake dammed up by a landslip at Gohna, in the Kumaun Himalayas, leave the impression that the dam burst and the lake was completely drained. This is incorrect. The accompanying extract shows that Mr. Holland's forecast, an abstract of which, with illustrations, appeared in NATURE, July 5, was singularly accurate. The whole occurrence is of remarkable geological interest, and it is important the correct facts should be known.

W. T. BLANFORD.

Weyburn, near Godalming, October 9.

Mr. Michie Smith, the Madras Astronomer, referring to the Gohna Lake, writes to the *Madras Mail*:—"My excuse for writing to you again on this subject is that I have now received trustworthy information regarding the present state of the lake, which makes it possible to compare Mr. Holland's forecast with what has actually taken place. In Mr. Holland's official report, he laid stress on three main points. (1) That the dam would not yield until the water overflowed it. This, as is admitted, was correct. (2) That the water would overflow the barrier about the middle of August. This was the result of a very intricate calculation, the data for which were obtained with great difficulty; yet, as we now know, this estimate was within ten days of the actual time, and on the safe side. Both these points were of much practical importance for the purpose of making arrangements in the valley below, and Government accepting the conclusions allowed traffic to continue in the valley for 160 miles till August 15. (3) Mr. Holland held that it was probable that 'there will be preserved above a lake 3¼ miles long and 1¼ miles wide, whose destruction by gradual erosion of the dam and silting up of the basin, though a matter of time geologically considered short, will be sufficiently slow for what historically may be called a permanent lake.' Now, what are the facts of the case? According to the latest trustworthy report from Gohna, a lake has been left which is over 3 miles long and 400 feet deep, and so far as it is possible to judge it will have the permanence predicted for it. I hold no brief for Mr. Holland, but it seems to me that his predictions, founded on careful research and accurate reasoning, have been fulfilled to a most remarkable degree, and that he has fully justified the confidence placed in him by the authorities."

Instinctive Attitudes.

DR. LIVINGSTONE makes this interesting observation: "Manyuema children do not creep, as European children do, on their knees, but begin by putting forward one foot and using one knee. Generally a Manyuema child uses both feet and both hands, but never both knees. One Arab child did the same; he never crept, but got up on both feet, holding on till he could walk." ("Last Journals," p. 381.) The last instance suggests arboreal survival, the Manyuema style being pure plantigrade, but rarely seen in civilised life. Creeping of infants as instinctive activity certainly throws light on human evolution, and it may be that racial differences will be revealed by investigation. It would also be interesting to inquire how far idiosyncrasy in walking is connected with peculiarity in creeping. Swinging the arms seems quadrupedal survival. Looking down from a high building on people walking below, their movements thus projected on a plane are strikingly suggestive of a quadruped, and the professional pedestrian who makes the utmost use of arm-swinging to accelerate gait suggests the rapid shuffle of a bear.

Again, the various attitudes instinctively assumed by persons for sleep are significant for the evolutionist. I know those who naturally dispose themselves flat on the stomach, with the limbs placed much like a dog asleep.

So far as habits of creeping, walking, and sleeping have not been taught, but are purely instinctive, they throw light on the history of man. It is very desirable that travellers and residents in all countries secure photographs of these attitudes, and deposit them with anthropological societies, where they would be of great use to the investigator.

HIRAM M. STANLEY.

Lake Forest University, October 3.

The Tetrahedral Carbon Atom.

IN the letter which he has addressed to you on this subject, it seems to me that Dr. Turpin has not succeeded in justifying his position. Whether your reviewer is or is not acquainted with all that has been written on the subject, is not a matter of great importance, though reference to the *Proceedings* of the Birmingham Philosophical Society (vii. part ii. p. 264) will be sufficient to show that the views of Wislicenus and Wunderlich have not been overlooked. The question is whether the writer of a text-book bearing on its title-page the word "Elementary," is justified in presenting without preface, and almost without explanation, a bald statement such as that complained of, which represents not the deliberate conclusions of the majority, or even of a considerable body of chemists, but speculations still in the earliest stage of evolution. (Wislicenus himself says, in reference to his own views, "Ich lege ihnen keineswegs den Werth einer wissenschaftlichen Ueberzeugung bei und möchte nicht auf ihnen 'festgenagelt' werden." *Ber.* xxi. 584.) I hope and believe that this sort of thing is not commonly taught to beginners in organic chemistry, and it may be as well for Dr. Turpin and his pupils to note that tetrahedral carbon is not referred to in any way in the syllabus of the first stage of organic chemistry in the Directory of the Science and Art Department.

W. A. T.

"Abstract Geometry."

I SEE your reviewer of Prof. Veronese's book on "Abstract Geometry" says: "Apparently this method" (that of pure geometry, free from axes, algebraic processes, &c.) "has not previously been applied to the discussion of space of more than three dimensions." Will you allow me to point out to him that this is a mistake? The case of four dimensions is discussed, and a general method indicated, in my "Foundations of Geometry," which was reviewed in your issue of April 6, 1891 (vol. xliii. p. 554). I have not yet read Prof. Veronese's book, but from your review I gather he treats the subject rather differently.

EDWARD T. DIXON.

Cambridge, September 28.

ON THE DOCTRINE OF DISCONTINUITY OF FLUID MOTION, IN CONNECTION WITH THE RESISTANCE AGAINST A SOLID MOVING THROUGH A FLUID.[1]

IV.

§ 25. ANOTHER decisive demonstration that the doctrine of discontinuity is very far from an approximation to the truth, is afforded, in an exceedingly interesting and instructive manner, by Dines' observations of the pressures on the two sides of a disk held at

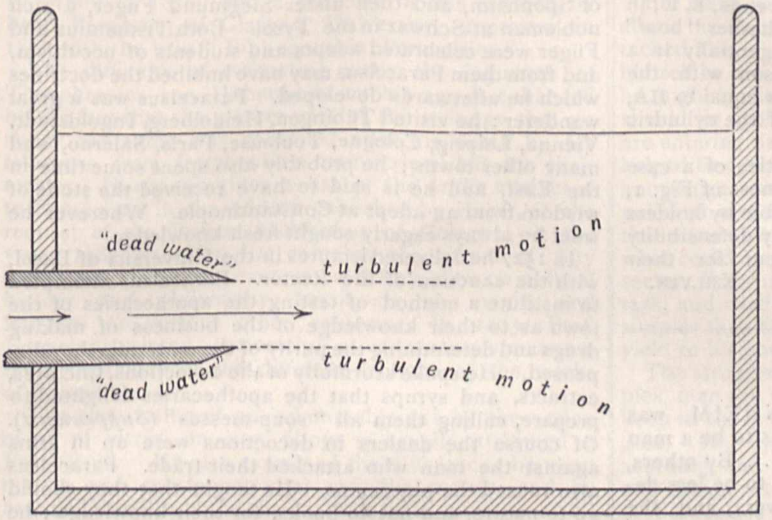

FIG. 2.

right angles to a relative wind of 60 statute miles per hour (88 ft. per sec.), produced by carrying it round at the end of the revolving arm of his machine. The observations were described in a communication to the Royal Meteorological Society in May 1890. In his paper of June of the same year, in the Royal Society Proceedings already referred to, he states the results, which are, that at the middle of the front side an augmentation of pressure, and at the middle of the rear side a diminution of pressure, measured respectively by $1{\cdot}82\,i$ and $\cdot 89\,i$ of water, were found. These correspond to heads of air, of density 1/800 of that of water, equal respectively to $121\frac{1}{3}$ and $59\frac{1}{3}$ feet. The former is in almost exact accordance with rigorous mathematical theory for an inviscid incompressible fluid; which gives $88^2/64{\cdot}4$, or $122\frac{1}{2}$ feet for the depth corresponding to the pressure at the water-shed point or points, of a solid of any shape moving through it at the rate of 88 feet per second. The latter shows that there is a "suction" at the centre of the rear side very nearly equal to half the augmentation of pressure on the front; instead of there being neither suction nor augmented pressure as taught in the doctrine of discontinuity!

§ 26. The accompanying diagrams (2, 3, 4, 5) represent several illustrations of the doctrine of discontinuity in the motion of an inviscid fluid, less attractive to writers on mathematical hydrokinetics than that represented in Fig. 1, (whether as it stands, or varied to suit oblique incidence), because each is instantly soluble without mathematical analysis, and they do not, like it in the two-dimensional case, constitute illustrations of the beautiful mathematical method for finding surfaces of constant fluid velocity in prolongation of given surfaces along which the velocity is not constant, originated by Helmholtz,[1] developed in a mathematically most interesting manner by Kirchoff,[2] and validly applied to the theory of the "vena contracta" by Rayleigh.[3]

§ 27. A cylindric jet (not necessarily of circular cross-section) issuing from a tube with *sharp edge*, into a *very large* volume of fluid of the same density as that of the jet, is represented in Fig. 2. This case was carefully considered by Helmholtz,[4] both for the ideal inviscid incompressible fluid and for real water or real air. He gave good reason for believing that, with real water or real air, and at distances from the mouth as great as several times the diameter of the tube (or the least diameter, if it is not of circular cross section) the surrounding fluid is nearly at rest, and the jet is but little disturbed from the kind of motion it had in passing out of the tube: and therefore that the efflux is nearly the same as, other circumstances the same, it would be if the atmosphere into which the jet is discharged were inertia-less. This conclusion, which is of great importance in practical hydraulics, has been confirmed by careful experiments made eight years ago in the physical laboratory of the University of Glasgow by two young officers of the American Navy, Mr. Capps and the late Mr. Hewes. I believe it has been tested and confirmed by other experimenters.

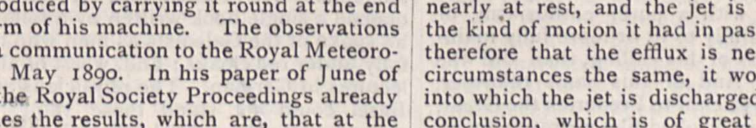

FIG. 3.

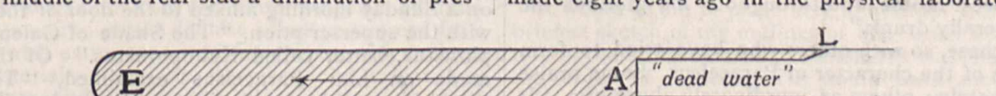

FIG. 4.

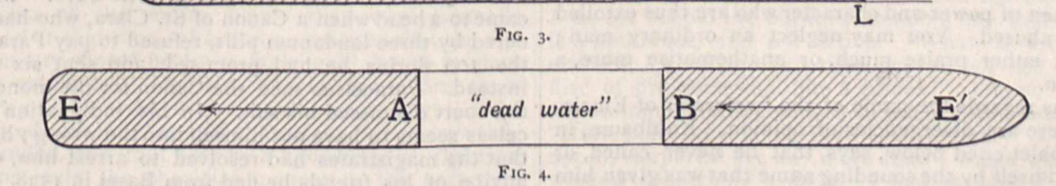

FIG. 5.

§ 28. The very simplest application of the doctrine of discontinuity to the theory of the resistance of fluids to

[1] Continued from page 575.

1 "Wissenschaftliche Abhandlungen," vol. i. pp. 153-156.
2 "Vorlesungen über Mathematische Physik," vol. xxi.
3 "Notes on Hydrodynamics," *Phil. Mag.* 1876, second half-year.
4 "Wiss. Abh.," vol. i. pp. 152-153.

solids moving through them, is represented in Fig. 3, and the result is no resistance at all! Surely this case, requiring no calculation, might have been a warning of the extreme wrongness of the doctrine in connection with resistance of fluids against solids moving through them. The nullity of the resistance in the case represented by Fig. 3 according to the assumption of a wake of "dead water" having the same pressure, Π, as the distant and near water flowing uniformly in parallel lines, follows immediately from an easily proved theorem which I stated in the combined meeting of Sections A and G in Oxford last August, to the effect that the longitudinal component of the pressure on each of the ends, E, E′, in Figs. 3, 4, 5, whatever their shapes, and whether "bow" or "stern" provided only that it ends tangentially in a cylindric "mid-body" long in comparison with the greatest transverse diameter of the solid, is equal to ΠA, where A is the area of the cross-section of the cylindric part of the solid.

§ 29. Figs. 4 and 5 represent two varieties of a case wholly free from the inconceivable endlessness of Fig. 1, and carefully chosen as thoroughly defensible by holders of the doctrine of discontinuity if it has any defensibility at all. I venture to leave it with them for their consideration. KELVIN.

PARACELSUS.[1]

"THEOPHRASTUS VON HOHENHEIM was adjudged by most eminent physicians to be a man of genius, indeed of superlative genius. . . . By others, who refused to follow him, he was thought to be less deserving than the cooks, the bellows-blowers, and the charcoal-burners." Thus spoke Lukas Gernler, Rector of the University of Basel, in 1660. Häser, in his "History of Medicine," says: "Probably no physician has grasped his life's task with a purer enthusiasm, or devoted himself more faithfully to it, or more fully maintained the moral worthiness of his calling, than did the reformer of Einsiedeln." And of this same reformer, Zimmermann, who was physician to Frederick the Great, wrote: "He lived like a pig, looked like a drover, found his greatest enjoyment in the company of the most dissolute and lowest rabble, and throughout his glorious life he was generally drunk."

As with these, so with others who have tried to form an estimate of the character of Paracelsus. Some praise him inordinately; others as inordinately abuse him. It is only men of power and character who are thus extolled and thus abused. You may neglect an ordinary man; you must either praise much, or anathematise more, a great man.

Even as regards the name of the "reformer of Einsiedeln" there are divergencies of opinion. Kahlbaum, in the pamphlet cited below, says that he never called, or signed, himself by the sounding name that was given him by some of his followers, who thought to awe the common people by styling their master "Philippus Aureolus Theophrastus Paracelsus Bombastus ab Hohenheim." For himself, Theophrast von Hohenheim was sufficient. On one occasion, says Kahlbaum, he used the name Aureolus, to distinguish himself from Theophrastus a disciple of Aristotle. The father of Paracelsus was a natural son of a member of the noble family of the Bombasts of Hohenheim, and he adopted their name as his own. In accordance with a fashion of the times, the name von Hohenheim was paraphrased into the classical tongues. *Paracelsus*, which may perhaps be rendered as "belonging to a lofty place," seems to be a kind of Græco-Latin form of von Hohenheim, the family name of Theophrastus. As von Hohenheim became *Paracelsus*, so Lieber became *Erastus*, and Schütz became *Toxites*; and in modern times the Jewish Neumann emerged from the baptismal font as *Neander*.

Paracelsus was born at Einsiedeln, in the canton of Schwyz, towards the end of the year 1493. He was educated for a time by his father, then by the monks of a convent in the valley of Savon, and then in the University of Basel. After leaving the University, Paracelsus studied under Johannes Trithemius, Abbot of Sponheim, and then under Siegmund Füger, a rich nobleman at Schwaz in the Tyrol. Both Trithemius and Füger were celebrated adepts and students of occultism, and from them Paracelsus may have imbibed the doctrines which he afterwards developed. Paracelsus was a great wanderer: he visited Tübingen, Heidelberg, Ingoldstadt, Vienna, Leipzig, Cologne, Toulouse, Paris, Salerno, and many other towns; he probably also spent some time in the East, and he is said to have received the stone of wisdom from an adept at Constantinople. Wherever he went he always eagerly sought fresh knowledge.

In 1527 he delivered lectures in the University of Basel, with the sanction of the Rector. Paracelsus attempted to institute a method of testing the apothecaries of the town as to their knowledge of the business of making drugs and determining the purity of the materials they dispensed. He spoke scornfully of the decoctions, tinctures, extracts, and syrups that the apothecaries delighted to prepare, calling them all "soup-messes" (*Suppenwust*). Of course the dealers in decoctions were up in arms against the man who attacked their trade. Paracelsus also roused the physicians. He taught that they should go to nature, and not to books, for their knowledge; he rebelled against the doctrine that was then held by almost every medical man, "the truth is to be found only in the ancients." He boasted that for ten years he had not opened a single book written by a follower of Galen, and he spoke of the Galenists as men who tried to hide their folly under red cloaks; and, worst of all, he delivered his lectures in German. The physicians and apothecaries of Basel could not stand these things. Paracelsus was abused not only publicly, but also in anonymous pamphlets; it is said that one of these productions was found on a Sunday morning affixed to the door of the Minster, with the superscription, "The Shade of Galen to Theophrastus, better called Kakophrastus." Of the attacks made on him Paracelsus exclaimed, "These vile ribaldries would raise the ire of a turtle-dove." Matters came to a head when a Canon of St. Clara, who had been cured by three laudanum pills, refused to pay Paracelsus the 100 florins he had promised, and sent six florins instead. Paracelsus sued the Canon for the money, but the court dismissed his suit. In his indignation Paracelsus seems to have put himself into the wrong; hearing that the magistrates had resolved to arrest him, on the advice of his friends he fled from Basel in 1528. After wandering about over a great part of Europe, Paracelsus found a resting-place at Salzburg, under the protection of the Archbishop Ernest. But he did not live long to enjoy the repose that had come at last. He died on September 24, 1541, after a short illness, in his forty-eighth year.

It is not possible to form a just estimate either of the character or the work of Paracelsus. The evidence is not sufficient, nor sufficiently trustworthy. Nevertheless we can draw some kind of picture of the man, and we are able to trace, in a hesitating way, the effects of his labours and his teaching on the progress of science. The pamphlet by Kahlbaum is concerned with dates, and the outward paraphernalia of the life of Theophrastus. Kopp gives a short account of the work of Paracelsus in

[1] "Theophrastus Paracelsus; ein Vortrag gehalten zu Ehren Theophrasts von Hohenheim, am 17 Dezember 1893, im Bernoullianum zu Basel." Von Georg W. A. Kahlbaum. 70 pp. (Bruno Schwabe, Basel, 1894.)

chemistry, pharmacy, and medical chemistry. The essential doctrines inculcated by the cosmogonist of Hohenheim are put into the language of modern mysticism by Hartmann, in his "Life of Philippus Theophrastus, Bombast of Hohenheim, known by the name of Paracelsus; and the substance of his teachings," published in 1887. A collection of the works of Paracelsus was made by Dr. E. Schubert; that author, and also Dr. Karl Sudhoff, have thrown much light on the history of Paracelsus. A pamphlet entitled "Theophrastus Paracelsus, Eine Kritische Studie," was published by F. Mook in 1876; and a criticism of this critique, by Prof. Ferguson, of Glasgow University, appeared in 1877 with the title "Bibliographia Paracelsica."

The difficulty of estimating justly the influence of Theophrastus von Hohenheim on his age is enhanced by the fact that the greater part of the writings that go under his name was compiled after his death by his followers, from fragmentary manuscripts left by their master. Hartmann gives a list of the works attributed to Paracelsus in the edition published by Huser, at the request of the Prince Archbishop of Cologne, in the years 1589–90. The list contains the names of fifty works on medicine, seven on alchemy, nine on natural history and philosophy, twenty-six on magic, and fourteen on various other subjects. In 1893, Prof. Ferguson printed (privately) a very complete annotated catalogue of the different editions of the works of Paracelsus.

The preparation of an inflammable gas by the action of oil of vitriol on iron filings is usually attributed to Paracelsus. He also examined the differences between metals and substances that are like metals, and he asserted ductility to be the characteristic property of all true metals. The differences between the vitriols and the alums were referred by Paracelsus to the presence in the former of metals, and in the latter of earths. He introduced into medicine many new and potent drugs, notably laudanum; and he constantly sought to determine the medicinal effects of the chemical substances that he worked with. Paracelsus was the first to make medicinal use of preparations of mercury, lead, and iron. He held that substances that were poisonous when administered in quantity might have healing properties when given in smaller doses and under proper conditions. In his endeavour to obtain definite substances, freed from admixture with extraneous and unnecessary, or perhaps hurtful, materials, he made tinctures and essences of various plants, and used these in place of the sweetened decoctions of the entire plants that were generally employed at that time. Paracelsus asserted that the aim of chemistry should be not to make gold, but to produce healing medicines. Medicine was for him a branch of chemistry. He insisted that apothecaries ought to be acquainted with the chemical characters of the drugs they compounded, and that only by a knowledge of chemical reactions could the physician restore to the perturbed bodies of his patients that chemical equilibrium which is health.

It is evident that a man who held and practised such views as these could not pay much respect to the physicians of his own time, whose highest ideal was to do what Galen had done, and to administer this or that drug because Avicenna laid it down, on such or such a page, that the drug ought to be administered. What the authorities of the schools were to his contemporaries, nature was to Paracelsus: the supreme court of appeal. Surrounded by prejudices, separated from nature by the thick veils that mediæval philosophy had drawn over men's eyes, bound by the formulas of his age—as we are bound by those of our age—Paracelsus nevertheless knew that the sun was shining on the other side of the mist, and that could he and others break through they would find the light. We can surely sympathise with his struggle. We may perhaps even recognise the essential rightness of the daring claim of the man who felt that the vision of nature could alone give understanding:—"After me, you, Avicenna, Galen, Rhasis, Montagnana, and the others. You after me, not I after you. You of Paris, you of Montpellier, you of Swabia, of Meissen, and Vienna; you who come from the countries along the Danube and the Rhine; and you, too, from the islands of the Ocean. Follow me. It is not for me to follow you, for mine is the monarchy."

But while we admire the audacity of the man, and even admit the force of his claim, we know that one who attacked the citadel of nature in this mood would dash himself to pieces before the outworks were carried. Yet he might make a breach through which a way for others should lie open. And Paracelsus succeeded in this; we are entering nature's strongholds by some of the ways he helped to open. With few appliances, with no accurate knowledge, with no help from the work of others, without polished and sharpened weapons, and without the skill that comes from long handling instruments of precision, what could Paracelsus effect in his struggle to wrest her secrets from nature? Of necessity, he grew weary of the task, and tried to construct a universe which should be simpler than that most complex order which refused to yield to his analysis.

The struggle is so arduous, nature is so infinitely complex, men are so easily led astray, that the giants alone keep to the quest, and they only go always forward to the goal. The syren-songs of the miracle-men are very soothing, and few escape. It is so pleasant to lie still and dream; it is so hard to get up and act. In the time of Paracelsus the air was filled with the soporific murmurings of industrious human bees. They were all busy secreting the wax of philosophising, that with it they might construct symmetric cells to be filled with the syrup of their own wisdom. Paracelsus, too, was obliged to become a wax-gatherer and a universe-maker. And a very remarkable universe he produced. The facts of nature that he sought were found so slowly that, in his impatience, he supposed the aim of science was to produce a completed scheme of things; and such a scheme he set himself to construct.

It would be out of place here to attempt more than the briefest sketch of the outlines of the Paracelsian conception of the order of nature. Paracelsus was essentially of the order of mystics. He would have adopted with enthusiasm the words of Blake: "I assert for myself that I do not behold the outward creation, and that to me it is a hindrance, and not action. 'What,' it will be exclaimed, 'when the sun rises do you not see a round disc of fire somewhat like a guinea?' Oh, no! no! I see an innumerable company of the heavenly host crying 'Holy, holy, holy, is the Lord God Almighty.' I question not my corporeal eye any more than I would question a window concerning a sight. I look through it, and not with it." Paracelsus insisted on the unity of all things; he taught that in everything in nature there is an inner and essential principle, which is itself a part of the universal life. There was for him an absolute and attainable knowledge; and although he admitted that much is to be learned from external nature, he taught that this real knowledge must be discovered by each man in himself. "Each man has . . . all the wisdom and power of the world in himself; he possesses one kind of knowledge as much as another, and he who does not find that which is in him cannot truly say that he does not possess it, but only that he was not capable of successfully seeking for it." Chemistry was regarded by Paracelsus as a spiritual art; an art that deals with the spiritual principles of things. Everything in nature was thought of by him as having a threefold character, as consisting of "a body and a soul held together by the spirit, which is the cause and the law." "To grasp the invisible elements, to attract them by their material correspondences, to control, purify, and transform them by the living power of the spirit—this is true alchemy." The pure, invisible, intangible, universal elements constituted the highest of the three orders of things; the second order was composed of "elements that are compounded, changeable, and impure, yet may by art be reduced to their pure simplicity"; and the third order contained the "twice compounded elements" which served as vehicles for drawing down the pure ethereal elements and fixing them in the substances of the second order. The laboratory was the place for learning the properties of the things of the second order; "for from these proceed the bindings, loosings, and transmutations of all things." Paracelsus speaks of the three substances of which all things are composed; these three things are "sulphur, mercury, and salt"; but he adds, "they are acted on by a fourth principle which is life." "These three substances," he says, "are not seen with the physical eye. . . . If you take the three invisible substances, and add the power of life, you will have three invisible substances in a visible form. . . . They are hidden by life, and joined together by life. . . . All things are hidden in them in the same sense that a pear is hidden in a pear tree and grapes in a vine. . . . A gardener knows that a vine will produce no pears, and a pear-tree no grapes"

I think it is possible from these extracts to construct, in a general way, the non-natural scheme of nature that was upheld by Paracelsus. A great deal may be said in its favour, if only we agree to construct the nature that is to be explained from our own consciousness with closed eyes. This certainly may be asserted in favour of the so-called spiritual science of Paracelsus and the mystics of his school, that their method is infinitely easier than the method of natural science, or, as it is called by the modern Paracelsians, materialistic and sceptical science. Whatever judgment may be passed on natural science when it is contrasted with supernatural mysticism, it is at any rate ludicrously erroneous to say that the former is proud, dogmatic, and conceited, while the latter is humble, suggestive, and ready to learn. The answer to the conception of the universe that Paracelsus framed is to be found in the history of science, and in the history of humanity, since the Middle Ages.

But however radically a modern naturalist may differ from the mediæval alchemist, he must recognise the great debt which those who to-day seek the knowledge of natural laws owe to the man of the sixteenth century who boldly declared against authority, and besought his followers to go to nature, who insisted on the interdependence of the various branches of natural knowledge, who taught the essential unity of the forms of matter and of the forms of energy, and who, by his discoveries in medicine, helped forward the blessed work of alleviating the miseries and soothing the sorrows of human beings. Whatever else he was, Paracelsus was certainly a true man; he lived earnestly; he was not regardful of the conventionalities of life; he received blows, and he returned them; he suffered much, and he bore his troubles on the whole with patience and some nobility. With his own words we may leave him:—"Have no care of my misery reader; let me bear my burden myself. I have two failings: my poverty, and my piety. My poverty was thrown in my face by a Burgomaster who had perhaps only seen Doctors attired in silken robes, never basking in tattered rags in the sunshine. So it was decreed that I was not a Doctor. For my piety I am arraigned by the parsons, for I am no devotee of Venus, nor do I at all love those who teach what they do not themselves practise." M. M. PATTISON MUIR.

ON HOLLOW PYRAMIDAL ICE CRYSTALS.[1]

I. *THE Lava Cavern of Surtshellir.*—The lava cavern of Surtshellir forms a long subterranean channel—over a mile in length—in the post-glacial lava-field which encompasses in a vast semicircle the ice-covered Eyríksjökull (Iceland). The farthest recess forms a chamber about 30 feet high, and from its floor and ceiling spring ice-stalagmites and stalactites of rare beauty. (Fig. 1.)

The north-western wall is gracefully draped by a long curtain of icicles resembling somewhat the pipes of an organ. From those parts of the vault not covered by icicles a thousand glitterings and sparklings are seen, at every movement of the candle, to be reflected from ice crystals which stud the walls.

The ice crystals have the form of hexagonal funnels, or hollow hexagonal pyramids. In size they range up to two inches long, with a hexagon side of half an inch. The triangular sides of the pyramids are built of most delicate steps of ice, arranged in the manner of a staircase.

The attachment is invariably by the apex, and the hexagonal bases turn trumpet-like towards the interior of the cave. (Fig. 2.) When these observations were made in June 1892, the temperature of the air in the cave was $+0{\cdot}5^{\circ}$ C.

There are some minute cracks in the roof of the cave, through which water trickles scantily. At such places *icicles* are formed, but not crystals. The crystals are not formed from the water percolating into the cave, but from the moisture contained in the air, and as such they must be regarded as a kind of *hoar-frost*.

II. *Hoar-frost.*—During Christmas week 1892 an unusually fine hoar-frost prevailed over the North of England. In various parts of Yorkshire, Lancashire, and Cheshire, we found the rime to consist almost entirely of hexagonal "hopper" crystals. (Fig. 3, *a*, *b*, *c*.) The basal hexagons varied up to about ⅜ inch in diameter, and the majority of the crystals measured in height about twice the diameter. (Fig. 3, *a*.) Some, however, were more obtuse. (Fig. 3, *b*.) The forms were often obliquely truncated (Fig. 3, *c*), certain faces having grown more rapidly than others. A spiral arrangement was noticed in some cases, and occasionally a double spiral resembling the helix of an Ionic capital. (Fig. 3, *d*.)

There was a marked tendency for the simple pyramids to group themselves into compound forms. (Fig. 3, *e*, *f*.) The groups exhibited hexagonal outlines (Fig. 3, *f*), and the primary pyramids on the periphery were, as a rule, better developed than those in the interior. The secondary hexagons often measured more than 1½ inches in diameter. Even a tertiary grouping could be made out in a few cases. In a few rare instances the primary hexagons were studded at the corners with small hexagons resembling bastions. These bastions were either solid or hollow. (Fig. 3, *g*.)

III. *Crystals under Ice-Crusts.*—On January 3, 1894, we found in Cheshire, during a severe frost, similar hexagonal hoppers on the under-surfaces of ice-crusts covering hollow spaces over ruts in clayey soil, or covering ponds where an air-space divided the ice from the water. No ice crystals were found on the sides and bottom of the ruts, and there was no trace of *hoar-frost* on adjacent objects.

These observations suggested the idea that *hoar-frost might be made at will* on any cold night. We accordingly spread pieces of black cardboard and black velvet over grass, and on examining these after two days of hard frost we found the *under*-surfaces coated with an abundance of hollow pyramidal and other forms of ice

[1] From a paper read before the Royal Society, by Dr. Karl Grossmann and Joseph Lomas.

crystals. No hoar-frost formed on the upper surfaces of the velvet or cardboard, and none existed on the grass.

IV. *Artificial Hoar-frost.*—Experiments had been planned before Christmas 1892, for the artificial production of hoar-frost. It was thought advisable, before completing our arrangements, to search for any possible traces of hoar-frost in the refrigerating chambers used for the frozen-meat trade in Liverpool. This visit rendered experiments unnecessary, as it yielded a rich harvest of simple and compound forms of hollow pyramidal crystals. All the variations observed in natural hoar-frost were met with, and the details of the forms were registered by microphotographs taken with magnesium light The ice chambers were cooled down to $-13°$ C.[1]

Very large and beautiful simple hoppers were obtained from ships used in the frozen-meat trade. During the four to six weeks of transit from the River Plate to Liverpool the hold is cooled down to about $-5°$ C., and the enclosed air is perfectly calm.

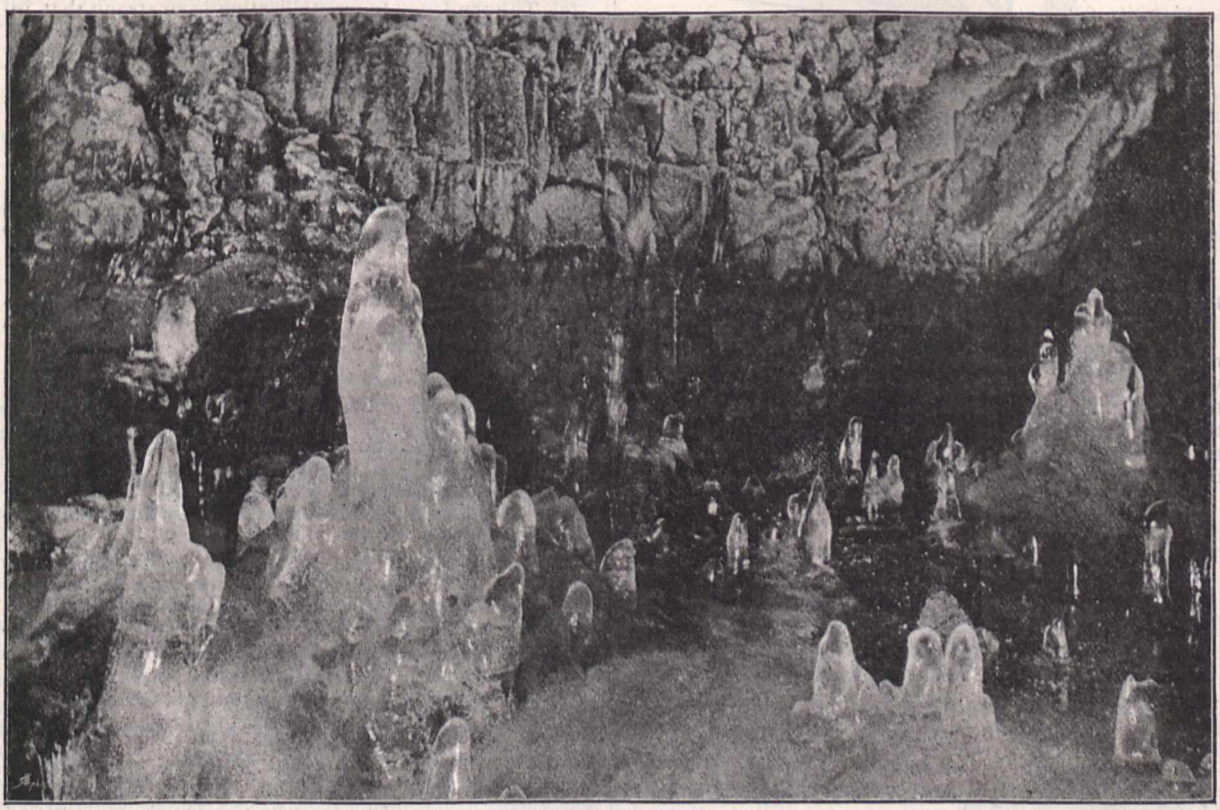

FIG. 1.—Ice Stalagmites in the Lava Cavern of Surtshellir (Iceland).

On the occasion of a visit to Berlin, in June 1893, the large cooling cellars connected with the "Muenchener Brauhaus" were examined (by kind permission of Director Arndt), and small hopper crystals were discovered on the cooling pipes.

V. *Comparison with other Skeleton Crystals.*—The simple hollow hexagonal pyramids of ice naturally suggest comparison with the well-known cubic "hopper" crystals of rock salt and skeleton crystals of other substances.

In crystal-building there is always a marked tendency towards excessive growth along the diagonal axes of the crystal. At the angles of crystals there is, for a given area, a larger supply of material for growth than in the middle of a side. Beautiful skeleton crystals of potassium chloride can be formed by rapidly cooling concentrated warm solutions. First, a great number of micro-crystals are formed, which float about in the brine. Any of these may form a centre of attraction round which crystalline matter will aggregate. A small cube will form the centre, and from each solid angle a straight axial row of small cubes will arise.[1] The intervening parts will gradually get filled up if sufficient time is allowed.

This type of skeleton crystal is evidently due to *overgrowth.*

Quite differently formed, though with the same result, are the hopper crystals of sodium chloride. NaCl is almost equally soluble in cold and hot water. Unaffected by cooling, it will therefore crystallise out of brine most rapidly where the concentration becomes greatest through evaporation, viz. at the surface. Suppose, then, a single cube to be formed at the surface. Beginning to sink, there will be deposits of fresh cubes on the four upper edges of the cube in the form of a step. This goes on until we have a floating hollow pyramid, apex downwards. At the corners of these hoppers additional cubes are formed. (Compare the analogy with the hexagonal form, Fig. 3, *g.*) These skeleton crystals are due to *growth at the upper edges of floating crystals.*

A third type of hollow skeleton crystals we have in hoar-frost.

When crystallisation of atmospheric vapour takes place in absolute freedom, we find the crystals mainly

[1] Our thanks are due to Mr. Ward for permission to work in the chambers of the Sausinena Company, and to Mr. Lintott, through whose help we were enabled to exhibit some of the ice crystals at the soirée of the Royal Society.

[1] See A. Knop. "Molekularconstitution und Wachsthum der Krystalle," p. 52. (Leipzig: 1867.)

developed in a plane perpendicular to the principal axis, as *flat* snow crystals. When, however, the atmospheric space is limited by a wall, first a small hexagonal disc of ice attaches itself to that wall. Then, as growth proceeds, in a calm or comparatively calm medium, the middle portion of the disc will be in contact with air

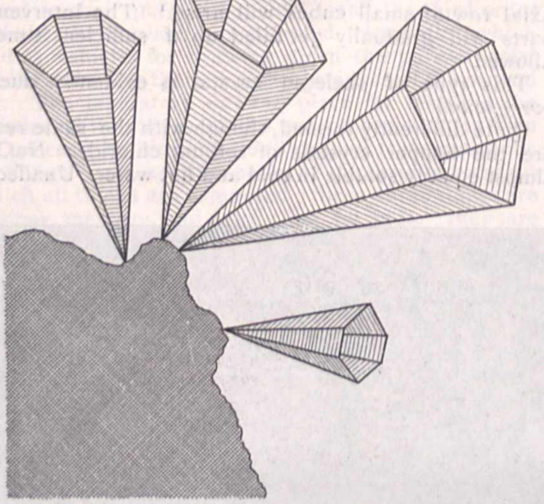

FIG. 2.—Hollow Hexagonal "Hopper" Crystals of Ice found in Surtshellir. (Natural size.)

robbed of its moisture, while the edges will grow outwards, the rate depending on the amount of food material. The open ends of the funnels will point towards the middle of the wall-bound air-chamber or cavern, or away from the wall; in the case of hoar-frost the funnels will be open towards the sky.

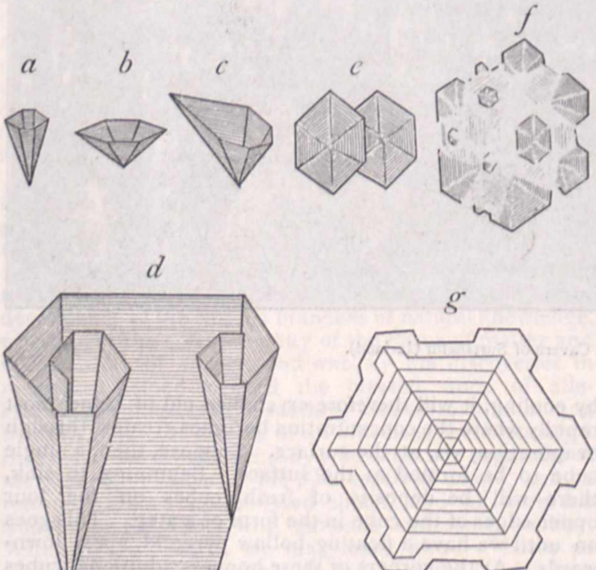

FIG. 3.—Natural Hoar-frost (Christmas 1892). (*a* and *f* natural size; *b*, *c*, *d*, *e* and *g* enlarged.)

This type of skeleton crystal may be termed *starvation crystal*.

By reflections from the steps seen on the triangular faces of the pyramids, we were able to show that they consist of combinations of faces of the hexagonal prism (∞ P) and the basal pinacoid (OP).

VI. *Literature.*—In 1697, Camerarius of Tübingen ("De figura nivis et pruinæ." *Misc. ac. natur.* Jenæ, Dec. 1697, p. 480) describes some hoar-frost on the lead bindings of windows as hexagonal discs, some of which had a central depression.

Dr. J. Krenner mentions, in his description of the ice cave of Dobschau ("A Dobsinai Jégbarlang." Budapest, 1874), flat hexagonal ice crystals, some depressed in the middle, or obtusely funnel-shaped.

In a paper entitled "Eine Krystallgrotte" (Groth's *Zeitschr. für Krystallographie*, 1888, xiv. p. 250), C. A. Hering mentions and illustrates fan-shaped ice crystals which probably are identical with those seen by Krenner, except that they are quite flat. On the upper surface of the fans some hexagonal hopper-shaped ice crystals were found.

VII. *Conclusions.*—(1) Water when changing direct from the gaseous into the solid state is highly crystalline.

(2) The tendency to crystallisation is so strong that in those cases where the area of supply is limited by a wall or other surface, skeleton crystals—hexagonal "hoppers"—are formed, growing away from the wall, even under circumstances of excessively slow growth.

(3) Calmness of air seems to be an essential condition for their formation.

(4) From our observations there can be no doubt as to the identity of the ice crystals of Surtshellir, of the refrigerating chambers and ships in Liverpool, and of the cooling cellars of the Berlin breweries, with natural hoar-frost.

THE GLACIAL SYSTEM OF THE ALPS.

ON the day following the close of the Sixth International Geological Congress an excursion, organised and conducted by Profs. Penck of Vienna, Brückner of Berne, and Dr. L. du Pasquier, left Lugano to visit the chief glacial deposits of the Alps. An excellent guide-book of permanent interest, entitled "Le Système Glaciaire des Alpes," had been prepared by the conductors of the excursion.

On the first day (September 17) the party, numbering thirty-five, took train to Sesto Calende, and descending the Ticino in boats, walked over the moraines of Lago Maggiore to Borgo Ticino. An excellent view of the morainic amphitheatre, which forms a loop round the southern end of the lake, and rises to 470 feet above its level, was obtained from the morainic Monte del Bosco. In the evening the party proceeded to Ivrea by rail.

Next day was spent in examining the celebrated moraines of Ivrea, which testify so eloquently to the size of the glacier that descended the valley of Aosta. From the northern morainic ridge (the Serra), which rises to a mean elevation of 1300 feet above the central depression, a good view of the great amphitheatre was obtained. Late at night Milan was reached.

On the 19th train was taken to Lonato at the southern end of the Lake of Garda, whence carriages were taken to Salò, on the western shore of the lake. On the way to Salò, most interesting evidence of three successive glaciations was seen. It is found that the moraines of the last glaciation show only a very thin weathered crust, whereas the moraines of the two previous glaciations are marked by a weathered crust called "ferretto," many feet thick, in which the pebbles, even of granite and gneiss, are so much decomposed as to be readily cut with a knife. The whole weathered crust has assumed a deep red-brown rust colour, whence the Italian name for it.

At Mocasina the unaltered lower part of a moraine of the second glaciation was seen overlying the much-weathered "ferretto" crust of a moraine of the first glaciation. At Benecco the unaltered moraine of the last glaciation overlies the "ferretto" crust of a moraine of the second glaciation. In the evening, Riva, at the head of the Lake of Garda, was reached by steamer.

On the 20th the party took train to Innsbruck. The following day was spent in examining the deposits at Hötting, close by the town.

The breccia of Hötting, considered by Penck a cemented cone of dejection or talus of rock-fragments, contains fossil plants (all but four of existing species). It overlies one moraine and underlies another, and is held to indicate an inter-glacial epoch.

On the 22nd Munich was reached, and some most interesting sections at Höllriegelskreut, seven and a half miles south of the city, were examined. Three successive fluvio-glacial deposits were seen, superposed one upon another, each corresponding to a separate glaciation. Here again the weathered (though not red) crust of the older fluvio-glacial deposits underlies the unaltered lower part of the succeeding deposit. The oldest of the three deposits (viz. the Deckenschotter, *alluvion des plateaux*) consists here almost exclusively of limestone pebbles, which are so solidly cemented together as to form a conglomerate used as a building stone.

The 23rd (last day of the excursion) was rainy, but the morainic amphitheatre of the Isar glacier around the Starnberger (Würm) See, near Munich, was examined as far as the weather would permit, and at the close of the excursion all members joined in an enthusiastic vote of thanks to its most excellent conductors.

B. HOBSON.

NOTES.

A FEW weeks ago the Paris *Figaro* opened a subscription list in order to enable the Pasteur Institute to supply Dr. Roux's anti-diphtheria serum to all medical applicants. The appeal has resulted in a sum equivalent to about £10,000 being raised. It is hoped that institutes in which experienced physicians will administer the cure will soon be established. The Paris Academy of Medicine has reported in favour of Dr. Roux's treatment.

WE learn with much regret that Mr. George Knott died at Cuckfield, Hayward's Heath, Sussex, on the 8th inst., at the age of fifty-eight. He was an eminent authority upon double and variable stars, to the observation of which he devoted his astronomical life. So long ago as 1861 he read his first paper before the Royal Astronomical Society, the subject being the variable star R. Valpecula. From that date to April 1892, when he communicated a series of observations of the magnitude of Nova Aurigæ, he contributed no less than twenty-four papers to the Society. In 1877 he completed a valuable series of micrometrical measures of double stars, taken by himself between 1860 and 1873. For many years he was a member of the Council of the Society. He was highly respected by his fellow workers, not only for his astronomical labours, but also for his sterling character. His death will be deeply regretted by all who were acquainted with him.

FROM a circular bearing the imprint of the University of Minnesota, Minneapolis, we learn that Mr. Clarke Barrows proposes to supply a complete up-to-date reference to all zoological literature by means of a card catalogue arranged alphabetically by authors, and supplemented with a subject catalogue. It is proposed to begin the catalogue with the current volumes of the more important periodicals devoting the whole, or a portion, of their space to zoology, to print the new titles as they appear, and take up the back volumes as rapidly as possible. It is hoped that arrangements will soon be made to get the titles of all other important zoological writings, and thus a catalogue of all the zoological literature not recorded in the "Bibliotheca Zoologica" up to 1861 will be produced. Each card will have printed upon it the name of the author of a zoological paper, the full title of the paper, and the name and date of the periodical in which it was published. The cards will be punched so that they can be stacked in drawers with a wire through them. They should be of great assistance to curators of zoological libraries.

THE Sunday Lecture Society will commence a new series of lectures next Sunday afternoon, at St. George's Hall, Langham Place, when Sir B. W. Richardson, F.R.S., will discourse on "Muscle and Athletic Skill."

THE steam yacht *Windward*, with Mr. Jackson's party on board, which left Archangel on August 5, is reported by the captain of a Norwegian walrus-hunting vessel, but the news is vague, being without exact dates, and the ship does not appear to have been "spoken." She was first seen about the middle of August off Matochkin Schar, the strait separating the two islands of Nova Zembla, where the ice was very heavy; and again about the end of August in lat. 75° 45′ N., and long. 44° E., steaming up a clear lead through rotten ice in the direction of Franz Josef Land.

MR. A. TREVOR-BATTYE and Mr. Hyland landed on the island of Kolguef, south-west of Nova Zembla, at the end of last June, with the special object of studying the ornithology of the island. His companion, Mr. Powis, returned for him in the steam-yacht *Saxon* on August 6, but not finding him at the landing place considered further search unnecessary and returned. Another Arctic steam-yacht made a remarkably cautious attempt to reach the island at a later date, but returned unsuccessfully, and Mr. Trevor-Battye has been left behind to face the Arctic winter without an adequate outfit. It is probable that when the winter ice unites the island to the continent, he will be able to cross to the mainland, a distance of less than sixty miles, and thence travel overland to St. Petersburg by sledge. It is to be hoped that he will be able to bring back his collections, which should be of considerable scientific value. A rescue expedition is proposed by Captain Battye-Trevor, but it is doubtful whether it can be carried out by sea at this advanced date. There seems no reason for anxiety, as game is usually plentiful on Kolguef, and there are habitable houses used temporarily in summer by Russians and Samoyedes.

WE have received a letter, written by Lieut. Peary to the President of the American Academy of Natural Sciences, which contains more detailed accounts of his expedition last season. When on the ice-cap in the spring of 1894, the average air-temperature experienced for forty-eight days was −31°·5 F., and the average wind velocity for forty-three days 15·9 miles an hour. During the worst weather there were thirty-four hours with an average temperature of −50° F. and a minimum of −62°, the average wind velocity being 48·1 miles per hour. The experience has convinced Mr. Peary that the human frame can stand any degree of natural cold without permanent injury. He intends to spend the coming winter in studying the Eskimo dog, and devising means to keep this invaluable animal alive and in health during extreme cold. There has evidently been some friction amongst the members of the exploring party, most of whom seem to have had enough of Arctic hardships, as the leader refers to the two men who remain with him as those who "decline to desert." The letter concludes: "You may rest assured that I shall not return until I have done everything that is possible for one who believes in ultimate success, and whose every fibre is in sympathy with and straining for the desired end."

WE are always glad to welcome any journal having for its object the extension of scientific knowledge; hence we note with pleasure the publication of the first number of the *Agricultural Journal of the Leeward Islands*, edited by Mr. C. A. Barber, the Superintendent of Agriculture at St. John's, Antigua, West Indies. The journal will ensure the rapid and wide publication of the results of investigations of interest to West Indian planters. It will be the medium through which the work carried on in the Government laboratories, and in experimental and botanical stations of the West Indies, will be made public. But besides being the organ of the scientific officers of the Government, the journal will contain reports of the proceedings of the agricultural societies in the colony, and facts of interest connected with the agriculture, natural history, and meteorology of the different islands will be recorded. To the number before us, the editor contributes some notes on the nature of the irritating ticks from which the cattle of the West Indies suffer. The journal also includes an article on the planting of eucalyptus trees; one on hurricanes, by Mr. F. Watts; and a third, on coffee planting in the Leeward Islands. The editor hopes to keep the journal scientific throughout, although it must be made eminently practical. We hope and believe that this addition to periodical literature will take a permanent stand among the scientific journals of the tropics.

THE current number of the *Comptes-rendus* contains a paper by M. R. Blondlot, on the propagation of electromagnetic waves in ice, and on the specific inductive capacity of this material. In a previous communication the author had shown that for turpentine and castor-oil the wave-length of the radiation given out by an oscillator, in these substances, is the same as in air; and enunciated the general law that the wave-length depends only on the dimension of the oscillator, and not on the medium in which the oscillator is plunged. There was, however, considerable doubt whether this law would be found to hold in the case of ice, for M. Bouty had found that the specific inductive capacity of ice was 78, that is enormously greater than in the case of any other dielectric. The apparatus employed consisted of two copper wires stretched horizontally and parallel at a distance apart of 80 cm. A resonator made of gilt copper, the same as that employed in the previous experiments on liquids (*Comptes-rendus*, July 25, 1892), was placed between these wires; the portion of the wires beyond the resonator pass through a wooden trough four metres long. This trough being empty, a bridge is moved along the wires beyond the resonator till the sparks disappear, the distance between the bridge and the resonator then being equal to the quarter wave-length of the resonator. The resonator is then surrounded with a water-tight bag filled with freshly-boiled distilled water, which is then frozen. The quarter wave-length is now found to be greater than before, in the ratio of 141 to 100 The trough is then filled with water which is frozen, and by breaking away the ice the place at which the bridge has to be placed in order to stop the sparking found. The wave-length under these conditions is exactly equal to that obtained when the resonator and wire are surrounded by air. The experiment was repeated four times, using resonators of different capacity, and in every case gave the same result. The results obtained can be utilised for calculating K the specific inductive capacity of ice, and give for K the value 2, which value the author considers correct to within about $\frac{1}{20}$. M. Blondlot having mentioned the above result to M. Pérot, who, working by means of electric oscillations, had found a very high value for K in the case of ice, the latter examined his results, and found that he had made an error in the formula he employed. Having applied this correction to his results, he now obtains the value 2·04 for the specific inductive capacity of ice.

A RECENT number of the *Atti della Reale Accademia dei Lincei* contains a paper, by M. Ascoli and F. Lori, on the radial distribution of the induced magnetism in an iron cylinder. The authors have investigated this question experimentally, using cylinders of different lengths in magnetic fields of varying strength. The cylinders employed were composed of 127 iron wires, each of 0·095 cm. in diameter. These wires were regularly arranged round a central wire in layers containing 6, 12, 18, 24, 30, and 36 wires respectively. Between each of the layers was wound a coil of fifty turns of fine insulated copper wire. By means of a series of mercury cups either of these six coils could be connected to a ballistic galvanometer. The authors find that for long cylinders (50 cm.) the distribution is practically uniform, while in the case of shorter cylinders there is an increase in the induction as you pass from the axis to the circumference. This increase is particularly noticeable in the case of short cylinders (5 to 10 cm.), and is greater in the case of strong than of weak inducing fields.

IN the *Journal* of the Scottish Meteorological Society (No. x. third series), Dr. Buchan has published a very valuable discussion of the mean monthly and annual rainfall of Scotland for the twenty-five years 1866 to 1890. He points out that of all the climatological elements, rainfall calls for the greatest number of years' observations in obtaining fairly approximate averages. The period of twenty-five years now dealt with, for a large number of stations, and for the same years, may well be accepted as a sound basis for discussion. In addition to the tables, and a discussion of the principal features of each month, the depth of rain for each month and for the year is shown on coloured maps. The part of Scotland where the rainfall is smallest is the low-lying district round the Moray Firth, where the annual amount varies from 23 to 26 inches, the absolutely dryest place being Nairn. Three parts of Scotland have an annual rainfall of upwards of 80 inches, viz. the south-western half of Skye, the highest mean annual fall being 92 inches, at Sligachan. To the west of the Caledonian Canal, in the central parts of Ross-shire and Inverness-shire and the north of Argyll, the average at some stations exceeds 100 inches; and to the south-east of the canal the averages are still larger, amounting to over 127 inches in Glencoe. The work will be referred to as the standard authority on the rainfall of Scotland, and when the publication of similar returns for the United Kingdom, now being prepared by the Meteorological Council, is complete, the distribution of the rainfall of these islands will be fairly accurately determined.

AT a recent meeting of the Berlin Physical Society, Herr E. Pringsheim exhibited some examples of the application ot photography to the deciphering of "palimpsest" manuscripts. A manuscript contained in the Royal Library at Berlin, on which the process was tested, showed the second writing intensely black, while the older writing, washed off as much as possible to make way for the new, was larger, and showed a yellow tint. The problem was to bring out in a photograph the feeble yellow writing without the later black manuscript, and this was accomplished as follows. A negative was first obtained through a yellow screen, using a long exposure and a flat development. This showed the older writing only very feebly, and the later very well. Another negative was taken with an ordinary bromide plate, was developed into a hard image, and used to obtain a diapositive. This transparency showed both writings with approximately equal intensity. The transparency was then placed upon the first negative so tha the two images coincided. In this case the background was dark in one case and light in the other, as was also the later manuscript. The latter therefore was imperceptible. But the older manuscript was dark in both cases, so that it appeared alone in the combination as an intensely black writing on a shaded ground. The greatest difficulty met with was that of obtaining two perfectly congruent negatives. An apparatus suitable for this purpose, in which the object and the camera were fixed in a definite position in an iron stand, was provided by Herr H. C. Vogel at the Potsdam Astrophysical Laboratory. But perfect coincidence was only obtained on taking the second negative through a glass plate of the same thickness as the yellow glass used for the first.

THE calendar of the University College, Nottingham, for the fourteenth session, 1894–95, has been published; and also the calendar of the University College of North Wales.

PART iii. of vol. vii. of the *Proceedings* of the Bristol Naturalists' Society has just been issued. It contains some of the papers read before the Society during the session 1893–94, and a portrait and short biographical notice of Dr. John Beddoe, F.R.S.

PROF. FRANK CLOWES and Mr. J. Bernard Coleman, of University College, Nottingham, have written a new work on "Elementary Qualitative Analysis," specially for the use of beginners. The book will be published by Messrs. Churchill, early in December.

MESSRS. LONGMANS AND CO. have just published "A Shilling Arithmetic," by J. Hamblin Smith, which is suitable as an introduction to the same author's "Treatise on Arithmetic." The book contains short explanations of arithmetical processes and a large number of simple examples.

MESSRS. MACMILLAN have in preparation a "Popular History of Celestial Photography," by Mr. R. A. Gregory and Mr. Albert Taylor. The book will be divided into twelve sections, each of which will trace the development of the application of photography to a particular branch of astronomical inquiry.

THE *Electrician* Printing and Publishing Co. has lately published the substance of the lecture on "The Work of Hertz," delivered by Prof. Oliver Lodge at the Royal Institution on June 1, and fully reported in these columns on June 7. Twenty-three illustrations have been introduced into the text, and abstracts of the work of some of Hertz's successors are given in appendices.

A MONOGRAPH of the land and freshwater mollusca of the British Isles, by Mr. J. W. Taylor, is in the press, and will shortly be issued. There will be two volumes, the first of which will be devoted to a general treatment of the subject, and the second to the treatment of species individually. Intending subscribers should communicate with Messrs. Taylor Bros., Sovereign Street, Leeds.

THE physical properties of soils are very inadequately described in most text-books. With a view of enabling teachers of agricultural classes to do fuller justice to this part of their subject, Prof. R. Warington, F.R.S., has drawn up a few "Brief Notes on the Physical and Chemical Properties of Soils" (Chapman and Hall). The notes will doubtless prove of great assistance to the science teachers for whom they are intended.

MESSRS. GEORGE NEWNES (Limited) announce that they propose to issue a series of little books dealing with various branches of scientific knowledge, and treating each subject in clear concise language, as free as possible from technical words and phrases. The following three volumes will be issued immediately:—"The Story of the Stars," by Mr. G. F. Chambers; "The Story of the Earth," by Prof. H. G. Seeley, F.R.S.; "The Story of Primitive Man," by Mr. Edward Clodd.

STUDENTS of human anatomy should find Mr. Gordon Brodie's "Dissections Illustrated," the third part of which has just been published by Messrs. Whittaker and Co., an invaluable handbook. The dissections illustrated and described in the new part refer to the head, neck, and thorax. There are twenty remarkably fine coloured plates, drawn and lithographed by Mr. Percy Highley, and eight diagrams. The plates are drawn so clearly, and they are so large (five are full size and the rest two-thirds natural size), that the muscles, vessels, and nerves of each dissection can be found without any difficulty.

SHORTLY before the fifth international congress of geologists, a "Geological Guide-book for an Excursion to the Rocky Mountains" was prepared by a number of geologists familiar with the different parts of the region visited, and was edited by Mr. S. F. Emmons. This book has been extracted from the *Compte rendu* of the congress, and is now published separately by Messrs. Kegan Paul, Trench, Trübner, and Co. A number of illustrations have been added to the original, and also many bibliographical references. The result is a capital account of the chief points in the geology of one of the most interesting regions of the world.

A REPORT on meteorological observations in British East Africa for 1893, by Mr. E. G. Ravenstein, has been received. The meteorological records, of which a summary is presented in the report, refer to seven stations on or near the coast, and two in the interior. At all these stations the temperature, rainfall, and other climatological factors have been recorded, and in the case of five of them the records embrace at least one year. Observations of the rainfall only have been recorded at four other stations. Mr. Ravenstein recognises that the observations are as yet far too scanty and imperfect to enable the true means of the temperature, rainfall, and humidity to be deduced.

DR. HARRISON ALLEN has revised and brought up to date his valuable "Monograph of the Bats of North America." The original work was issued nearly thirty years ago by the Smithsonian Institution, and has remained the only work on the subject. The progress made in systematic zoology since that time, however, rendered it desirable to prepare a new edition. The monograph just distributed by the Institution is essentially new. Dr. Allen has added to the species, elaborated the descriptions, and introduced several novel features. These changes have increased the usefulness of a very important work, and they will be welcomed by students of what is recognised to be a difficult group of animals.

MR. GISBERT KAPP has revised and largely rewritten his work on the "Electric Transmission of Energy" (Whittaker and Co.), the fourth edition of which was published last week. Changes were rendered necessary on account of the enormous developments which have taken place in every branch of electric power transmission since the third edition was published. The author has omitted a large amount of the descriptive matter, and has given a greater amount of space to the theoretical part of his subject. Among the omissions are "the historical account of power transmission, detailed descriptions of plants, comparison of electric with other systems of transmission, underground cables, electric tramways, and telpher lines." Altogether the book, as at present constituted, is more scientific, and less a trade catalogue than formerly.

Messrs. J. J. Griffin and Sons have recently published the third edition of their illustrated and descriptive catalogue of chemical apparatus. A few of the new instruments are worthy of notice. For instance, a new pattern of Tate's air-pump, described in the catalogue, has been designed with valves at each end of the barrel so that no air can exist between them and the pistons, hence, at each stroke, all the air contained in the barrel is expelled. Metallurgists will be interested in a new form of gas furnace capable of carrying on operations at a white heat without the aid of a blower; the power of the furnace may be judged from the fact that one pound of cast iron can be melted in thirty-five minutes. A cathetometer which enables the operator to turn the telescope in any direction without moving the instrument bodily, is another noteworthy feature. Arnold and Hardy's apparatus for the estimation of sulphur in steel and steel-making iron; benzoline blast furnaces attaining a temperature of 2100° F.; Prof. Roberts-Austen's electrical pyrometer; and many other pieces of apparatus, for use in teaching and research, have been introduced into the catalogue.

A considerable addition to our knowledge of the chemical history of hydrazine or diamide and its derivatives is contributed by Prof. Curtius, its discoverer, and his assistants, to the current issue of the *Journal für praktische Chemie.* An interesting account is given of the position of diamide as a salt-forming base, and its relations in this respect to ammonia and the fixed alkalies. Diamide itself, $\begin{matrix} NH_2 \\ | \\ NH_2 \end{matrix}$, is an extremely unstable substance, so much so that it is still doubtful whether the anhydrous gas has yet been obtained, or is even capable of separate existence. On the other hand, the liquid hydrate, $N_2H_4.H_2O$, is a very stable substance, as Prof. Curtius has long ago shown. It is interesting to note that this is the opposite of what is the case with ammonia, where the gas itself is stable and the hydrate particularly unstable. Moreover, while ammonia is a mon-acid base, diamide is di-acid; and just as we accept the idea of a hypothetical ammonium radicle NH_4, so we are bound likewise to admit the conception of a divalent radicle $\begin{matrix} NH_3 \\ | \\ NH_3 \end{matrix}$, which Prof. Curtius terms diammonium, in the hydrazine salts. Thus the normal chloride of hydrazine is $\begin{matrix} NH_3Cl \\ | \\ NH_3Cl \end{matrix}$ and the sulphate $\begin{matrix} NH_3 \\ | \\ NH_3 \end{matrix}\!\!>SO_4$. Diammonium would thus seem to be analogous to the divalent metals of the alkaline earths, and the parallel would appear to be further justified by the sparing solubility of the sulphates and their inability to form alums with sulphates of the alumina group. On the other hand, diammonium exhibits properties which point to a close similarity to the alkali metals. For the hydrate behaves in by far the greater number of instances as a mon-acid base, like ammonium hydrate. The neutral chloride above mentioned, $N_2H_6Cl_2$, decomposes below 100° into hydrogen chloride and the chloride N_2H_4HCl, which cannot be made to lose more hydrochloric acid without destruction of the base. The hydrate $N_2H_4.2H_2O_2$ is only capable of existence in solution; it passes on evaporation into the hydrate $N_2H_4.H_2O$, which latter substance boils without decomposition. Dry ammonia gas only displaces half the acid of the sulphate $N_2H_4.H_2SO_4$, and leaves the stable sulphate $(N_2H_4)_2H_2SO_4$. Moreover, Prof. Curtius has only succeeded in preparing one nitrate, $N_2H_4.HNO_3$, and one thiocyanate, $N_2H_4.SCNH$. Hence he concludes that diammonium is capable of acting both in a monovalent capacity as $(N_2H_5)'$, and as a divalent radicle $(N_2H_6)''$, the former resulting in the production of the more stable salts.

Prof. Curtius has succeeded in preparing a large number of double salts containing diammonium, and describes them in a separate memoir in conjunction with his assistant, Herr Schrader. Ammonium, as is well known, forms three classes of double salts containing sulphuric acid, namely, the alums, the double sulphates with $6H_2O$, and the peculiar and as yet little understood salts usually formulated as $R''SO_4.nNH_3$ in which the anhydrous gas is assumed to enter into combination with the metallic sulphate. All efforts to obtain alums containing diammonium sulphate, $N_2H_6SO_4$, have so far failed: but salts of the other two types, containing the more stable sulphate $(N_2H_5)_2SO_4$, are readily obtained. It is somewhat singular, however, that they contain no water of crystallisation, a fact which is possibly explained by the difficult solubility of the compounds. The divalent metals present may be copper, nickel, cobalt, iron, manganese, cadmium or zinc, but not magnesium. They are at once precipitated upon mixing concentrated solutions of the metallic sulphate and diammonium sulphate. It is further remarkable that the latter may be either of the two sulphates of diammonium; indeed, the solution may contain free sulphuric acid. Moreover, the sulphate $N_2H_6SO_4$ is difficultly soluble, while the more stable sulphate $(N_2H_5)_2SO_4$ is deliquescent, and yet the sparingly soluble double salts always contain the deliquescent diammonium sulphate. In addition to these, salts of the type $R''SO_4.2N_2H_4$ and $R''SO_4.3N_2H_4$ have been obtained; in those of the former type R'' may be zinc or cadmium, corresponding to the ammonia compounds $R''SO_4.4NH_3$, and in those of the latter type nickel or cobalt, these salts being analogous to the well-known compounds $NiSO_4.6NH_3$ and $CoSO_4.6NH_3$. In direct opposition to the ammonia compounds, the salts containing anhydrous hydrazine are almost perfectly insoluble in water.

The additions to the Zoological Society's Gardens during the past week include two Pig-tailed Monkeys (*Macacus nemestrinus*, ♂ ♀) from Java, a Vervet Monkey (*Cercopithecus lalandii*, ♀) from South Africa, presented by the Rev. Sidney Vatcher; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. E. Logan; a White-backed Piping Crow (*Gymnorhina leuconota*) from Australia, presented by Miss Vincent; a Manx Shearwater (*Puffinus anglorum*) from Cornwall, presented by Mrs. E. S. Smith; two Robins (*Erithacus rubecula*), South European, presented by Mr. A. T. Binny; a Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mr. W. L. Strong; a Deadly Snake (*Trigonocephalus atrox*) from Trinidad, presented by Dr. A. Strading; a Yak (*Poëphagus grunniens*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Rio de Janeiro Observatory.—The Brazilian National Observatory, situated on the Morro do Castello, the most easterly hill of Rio de Janeiro, is to be removed. The *American Meteorological Journal* reports that the unfavourable situation of the Castello for astronomical observations has led to the selection of a site across the bay, near Petropolis, at an elevation of about 3500 feet. A road is now being built up the mountain, and it is hoped that the new observatory will be completed within two years. The sum of five hundred thousand dollars has been voted by the Government for the installation.

Observations of Mars.—The current number of the *Observatory* contains a short article in which Mr. Stanley Williams directs attention to certain important features of Mars, which, it will be remembered, is in opposition on Saturday. With regard to the canals or channels, he remarks that a few points upon which observations are desirable are: "How far is the visibility of the canals in different parts of the planet affected by seasonal changes? Their duplication, when does it occur? How long does it last? How does it occur? And again, how far is it subject to seasonal changes?" Mr. Williams commenced observations in the latter part of August, and he found that the plainer canals were conspicuous, and even those of average distinctness could be seen without much difficulty. At the date of writing (September 18) he had observed about thirty of the canals, although only about two-thirds of the planet's face had been examined. *Ganges* was seen double on August 29, but not so clearly as in 1892. *Gehon* was also seen plainly double on the same date. Three other canals—*Eunostos*, *Cyclops*, and *Cerberus*—were found distinctly duplicated, and the germination of *Phison* was suspected. The observations were made almost exactly at the time of the summer solstice of Mars' southern hemisphere. Mr. Williams has observed a few small dark spots similar to the "lakes" detected by Prof. W. H. Pickering at Arequipa in 1892.

THE MASS OF MERCURY.—M. Backlund's recent researches on the mass of the planet Mercury, and the acceleration of the mean movement of Encke's comet, are described by M. Callandreau in *Comptes-rendus* of October 1. Encke's comet is interesting not only on account of the diminution of its period of revolution (about two hours from one apparition to the next), but also from the fact that its movement is disturbed by Mercury. A discussion of the seven apparitions of the comet between 1871 and 1891 has led M. Backlund to conclude that Mercury has a much smaller mass than has hitherto been ascribed to it. The value obtained is

$$\text{Mass of Mercury} = \frac{1}{9{,}647{,}000}.$$

It would, therefore, take about 9,700,000 bodies like Mercury to make up the mass of the sun.

To account for the acceleration of Encke's comet, it has been supposed that a resisting medium of some kind is uniformly distributed round the sun. M. Backlund, however, thinks that all hypotheses of a continuous resisting medium of uniform density ought to be discarded, and that the resistance is very probably met only in certain regions. This idea is a very plausible one, for, according to Laplace's hypothesis, in the formation of the planets from the solar nebula, all the substance of the rings would not be used up in the process, and some of it would without doubt travel along the planetary orbits as clouds of very light material. It is suggested that Encke's comet passes through nebulous clouds of this kind, and that the resistance they offer causes the observed acceleration of the mean motion.

BRORSEN'S COMET 1851 III.—This comet first appeared in the month of August 1851, moving in the constellations of Bootis and Draco. On forty-one evenings observations were made, besides numerous measures of position with micrometers, and many have been the attempts to deduce an accurate orbit. Among these may be mentioned Rümker (*Astr. Nach.*, No. 771), Vogel (*Astr. Nach.*, No. 774), Brorsen (*Astr. Nach.*, No. 775), and Tuttle (*Astr. Journal*, II.), who found parabolic elements, none of which satisfied the observations sufficiently. At a later date Brorsen obtained elliptical elements (*Astr. Nach.*, No. 782), which he compared with all the then known observations. In the communication before us, on a new determination of the orbit of this comet by Dr. Rudolf Spitaler (lxi. *Denkschriften der Math. Naturwiss. Classe der k. Ak. der Wissenschaften*), the writer makes use of some new observations and more accurate places for the camparison stars. To limit this note we will state in a few words the result he has obtained. The most probable parabolic elements after two or three "verbesserungen" were

$$\tau = 1851 \text{ August } 26 \cdot 2523 \text{ Paris Mean Time.}$$

$$\left.\begin{array}{l} \pi = 310^\circ\ 57'\ 25''\cdot 7 \\ \Omega = 223\ \ 40\ \ 21\cdot 2 \\ i = \ \ 38\ \ 12\ \ 57\cdot 5 \end{array}\right\} \text{Eq. } 1851\cdot 0.$$

$$\log q = 9\cdot 9933272$$

An attempt to improve this led to elliptic elements as follows:—

$$\tau = 1851 \text{ August } 26 \cdot 249997 \text{ Paris Mean Time.}$$

$$\left.\begin{array}{l} \pi = 310^\circ\ 57'\ 19''\cdot 2 \\ \Omega = 223\ \ 40\ \ 33\cdot 9 \\ i = \ \ 38\ \ 12\ \ 52\cdot 9 \end{array}\right\} \text{Eq. } 1851\cdot 0.$$

$$\log q = 9\cdot 9933235$$
$$e = 0\cdot 9999151$$

Both these elements give ephemerides which agree well with the observations, and can be looked upon as accurate within the limit of error of the observations.

M. PAPAVASILIORE ON THE GREEK EARTHQUAKES OF APRIL, 1894.[1]

THE earthquake series to which this abstract refers consisted of two principal shocks and a large number of minor ones, the former felt throughout all Greece and far beyond, but chiefly affecting the north-east region of continental Greece, and especially the province of Locris.

The first great shock occurred on April 20, and was registered by a seismoscope at the observatory of Athens at 6h. 52m. p.m., Athens mean time. The region in which much damage was done may be divided into three principal zones. (1) The epicentral zone, comprising the peninsula of Æolymion (west of Cape Theologos). Three villages were completely destroyed; 180 persons were killed, and 27 wounded. (2) The zone in which nearly all the buildings were overthrown. This is in the form of an ellipse whose major axis is 28 km. long, and extends in a south-east and north-west direction from the Bay of Larymne to near Cape Arkitza; the minor axis is 8 to 9 km. in length. Nine villages were affected; 44 persons were killed, and 20 wounded. (3) The zone in which houses were much damaged or partially fell, also in the form of an ellipse. The major axis is 90 km. in length, directed south-east and north-west, and reaches from Dritza to near Molos. The minor axis is 65 km. long, and extends from Levadia to Mantoudi in the Island of Euboea.

During the night of April 20-21, the ground in the first and second of these zones was in a state of almost incessant disturbance, interrupted often by stronger shocks. For three days shocks were very frequent throughout all three zones; then they became more and more rare until, on April 27, a second great shock occurred, more violent than the first, and registered at the Athens Observatory at 9h. 21m. 6s. p.m., Athens mean time. The same continual disturbance of the ground followed as before.

This second shock disturbed a greater area than the first. The major axis of the second zone is 30 km. longer, especially towards the north-west; it reaches from the Bay of Scroponeri to St. Constantin. The major axis of the third zone is lengthened by about 22 km. to the town of Lamia. The minor axes of these zones are also several kilometres longer, especially on the south-west side. The same villages suffered, but the amount of damage was greater.

This earthquake was a remarkable one in several ways. At the moment of the shock, the sea rose in a wave which submerged the whole coast from the Bay of St. Theologos to St. Constantin. The water afterwards retired, except in the Plain of Atalante, where the greater part of the coast is now submerged for a distance of some metres. Several springs have ceased to run, while others have increased their flow. New thermal springs have started up at Ædipsos, near pre-existing ones, and similar in nature. Numerous fissures, occasionally some kilometres in length, have been formed.

But the most remarkable phenomenon of all is the production of a great fissure about 55 km. long. Its breadth varies from a few centimetres to three metres, according to the nature of the ground, being on an average about half a metre. It extends in a constant east-south-east and west-north-west direction from the Bay of Scroponeri through Atalante, until it disappears near St. Constantin. This fissure appears to be a fault, on account of (1) its extraordinary length and its parallelism to the Gulf of Euboea; (2) the constancy of its direction and its independence of geological structure; and (3) the existence of both a throw and horizontal displacement along the fissure, causing a lowering of the Plain of Atalante and a slight shift towards the north-west. The throw is generally very small, often zero on Cretaceous ground, reaching several centimetres on the Tertiary formations, and as much as $1\frac{1}{2}$ metres on the alluvial beds of the Plain of Atalante.

M. Papavasiliore regards this fault as one of the series which, at the end of Tertiary or beginning of Quaternary times, gave rise to the Gulf of Euboea, and the recent earthquakes as due to orogenic movements by which the width of the gulf may in future be still further increased.

C. DAVISON.

[1] Abstract of two papers by M. S. A. Papavasiliore: (1) "Sur le tremblement de terre de Locride (Grèce) du mois d'avril 1894"; (2) "Sur la nature de la grande crévasse produite à la suite du dernier tremblement de terre de Locride."—*Comptes-rendus*, vol. 119, 1894, pp. 112-114, 380-381.

THE AFFILIATED SOCIETIES OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

IN the general report of the Brooklyn meeting of the American Association for the Advancement of Science, given in these columns on September 6, it was pointed out that a marked feature of recent meetings has been the increasing number of affiliated societies which hold meetings in connection with the Association. A useful purpose may be served by recording the communications made to these Societies.

The following papers were down in the programme of the American Mathematical Society:—Theorems in the calculus of enlargement, by Dr. Emory McClintock; on the expression of the roots of algebraic equations by means of series, by Dr. Emory McClintock; elliptic functions and the Cartesian curve, by Prof. Frank Morley; concerning the definition by a system of functional properties of the function $f(z)=\frac{\sin \pi z}{\pi}$, by Prof. E. Hastings Moore; Bertrand's paradox and the non-Euclidean geometry, by Prof. George Bruce Halsted; analytical theory of the errors of interpolated values from numerical tables, by Prof. R. S. Woodward; upon the problem of the minimum sum of the distances of a point from given points, by Prof. V. Schlegel; on the fundamental laws of algebra, by Prof. Alexander Macfarlane; about cube numbers whose sum is a cube number, by Dr. Artemas Martin; reduction of the resultant of a binary quadric and m-ic by virtue of its semicombinant property, by Prof. Henry S. White.

The Society for the Promotion of Engineering Education had papers and discussions upon a number of interesting matters. Promoters of technical education in Great Britain will see, from the following list of subjects, that the matter is considered from many points of view in America.

Among the subjects discussed were:—Entrance requirements common to all engineering schools, by F. O. Marvin; engineering education and the State University, by W. M. S. Aldrich; text-books considered as such and not as works of reference, by C. H. Benjamin; graduate and post-graduate engineering degrees, by Palmer C. Ricketts, Geo. F. Swain, and Robert H. Thurston; teachers and text-books in mathematics for engineering students, by Mansfield Merriman; teaching engineering specifications and the law of contracts, by J. B. Johnson; teaching mechanical drawing and lettering in engineering schools, by J. J. Feather; early instruction in physics and mechanics, by C. M. Woodward: some German schools of engineering, by Storm Bull; the organisation and conduct of engineering laboratories and the equipment of the laboratories at the Massachusetts Institute of Technology, by Gaetano Lanza; electrical engineering laboratories, by D. C. Jackson.

The Civil Engineering section of the Society had papers and discussions on:—Minimum laboratory work and equipment in a civil engineering course, by Dwight Porter; a few mistakes in the conduct of college field practice, by O. V. P. Stout; the teaching of structural engineering, by Edgar Marburg; relation of practical to theoretical work in civil engineering courses, by Olin H. Landreth; the education of civil engineers for railroad service, by C. Frank Allen.

The subjects brought before the Mechanical and Electrical Engineering section were:—Mechanical laboratory work at Ames, Iowa, by G. W. Bissell; amount and kind of shopwork required in a mechanical engineering course, by C. W. Marx; teaching machine design, by J. H. Barr.

The programme of the Society for the Promotion of Agricultural Science included the vitality of seeds of red clover and of seeds of weeds, by W. J. Beal; the Russian thistle in Nebraska, by C. E. Bessey; climate in its relation to rust, by L. H. Pammel; (1) a possible relation between blights and exceptional weather; (2) notes upon field experiments, by B. D. Halsted; crimson clover, some observations in reference to methods and times of seeding, by E. B. Voorhees; the growth of lettuce as affected by the physical properties of the soil, by B. T. Galloway; cañaigre, its cultivation and preparation for market, by F. A. Gulley; the effect of different fertiliser constituents upon the composition and combustibility of tobacco, by H. J. Patterson; the oil of the black walnut, by W. E. Stone; nurseries as factors in the distribution of insect pests, by J. B. Smith; Bordeaux mixture as a remedy for flea beetles on potatoes, by L. R. Jones; an inquiry into the relation existing between the Burrill disease of corn and the so-called "cornstalk disease" of cattle, by V. A. Moore; a simple milk-sampling tube, by M. A. Scovell.

The following papers were read before the Geological Society of America:—The nickel mine at Lancaster Gap, Pa., and the pyrrhotite deposit at Anthony's Nose, on the Hudson, by J. F. Kemp; a connection between the chemical and optical properties of amphiboles, by Alfred C. Lane; on a basic rock derived from granite, by C. H. Smyth, jun.; the process of segregation as illustrated in the New Jersey Highlands, by Ralph S. Tarr; alunogen and bauxite of New Mexico, with notes on the geology of the Upper Gila region, by Wm. P. Blake; a study of the cherts of Missouri, by Edmund Otis Hovey; use of the aneroid barometer in geological surveying, by Charles W. Rolfe; platycnemic man in New York, by Will H. Sherzer; oil and gas in Kansas, by Erasmus Haworth; dislocations in certain portions of the Atlantic coastal plain strata and their probable causes, by Arthur Hollick; faults of the region between the Mohawk river and the Adirondack mountains, by N. H. Darton; reconstruction of the Antillean continent, by J. W. Spencer; evidences as to the change of sea-level, by N. S. Shaler; the extension of uniformitarianism to deformation, by W. J. McGee; Tertiary and early Quaternary base-levelling in Minnesota, Manitoba, and north-westward, by Warren Upham; departure of the ice-sheet from the Laurentian lakes, by Warren Upham; the drumlinoid hills near Cayuga, N.Y., by Ralph S. Tarr; drumlins in the vicinity of Geneva, N.Y., by D. F. Lincoln; channels on drumlins, caused by erosion of glacial streams, by George H. Barton; review of our knowledge of the geology of the Californian coast ranges, by Harold W. Fairbanks; the geological history of Missouri, by Arthur Winslow; the magnesian series of the North-western States, by C. W. Hall and F. W. Sardeson; the stratigraphy of the St. Louis and Warsaw formations in South-eastern Iowa, by Charles H. Gordon; the Permo-carboniferous and Permian rocks of Kansas, by Charles S. Prosser; the Trias and Jura of Shasta County, California, by James Perrin Smith; cenozoic history of a portion of the middle Atlantic slope, by N. H. Darton.

A number of papers were read before the Association of Economic Entomologists, and the president, Prof. L. O. Howard, delivered an address on "The Rise and Present Status of Official Economic Entomology."

Prominent among the Societies that met in connection with the American Association is the American Chemical Society, having a membership of nearly eight hundred. The following were among the papers read:—Recent progress in the detection of adulteration in lard, by H. W. Wiley; Ucuhuba fat, by Joseph F. Geisler; oxidation of non-drying oils by air, by Walter D. Field; a new and rapid method of estimating the total proteids in milk, by E. H. Bartley; inspection of cotton for use in gun-cotton manufacture, Chas. E. Munroe; ferric acid and the ferrates, by C. A. O. Rosell; some points in making molybdate of ammonia solutions for phosphorus determinations, by Charles B. Dudley; report on abbreviations of the names of metric terms used by chemists, by Wm. H. Seaman.

In the course of an interesting address delivered before the American Association of State Weather Services, Major H. H. C. Dunwoody, the acting chief of the National Weather Service, remarked that the three thousand voluntary observers who take observations of temperature and rainfall, and record miscellaneous meteorological phenomena, render it possible to supply, through the State Weather Service, climatological information for almost any locality in the United States. Nearly every county in the whole country is now provided with a station equipped with instruments of the Government standards, and if the work of establishing new stations continues during the next two years at the same rate as during the past two years, there will not be a county within the limits of America that will not have a meteorological station.

The weather crop service of the National Bureau now undoubtedly ranks next in importance to the work of making forecasts. The system of gathering reports upon which the weather crop bulletins are based has been so perfected in recent years, that further improvement in some States can scarcely be expected. The crop bulletins of the States have been improved, and are now more complete than at any previous time, and the increased circulation that these bulletins has attained amply attests their value. It is believed that there is no other class of information to which so much space is at present devoted in the public press of America.

More than 10,000 crop correspondents are to-day co-operating with the National Weather Service through the State organisations; 3000 voluntary observers are furnishing monthly reports of daily observations of temperature and rainfall; and over 11,000 persons assist in the work of distributing the weather forecasts of the National Weather Service. This latter work has been more rapidly pushed during the past year than any other feature of State Weather Service work, and it is expected that during the ensuing year the already large number of communities receiving the Government weather forecasts will be further increased from 5000 to 6000. With a continuation of the present liberal policy of the Secretary of Agriculture and the Chief of the Weather Bureau towards these services, there will be in a comparatively short time no important agricultural community in the United States, with the proper mail facilities, that will not receive the benefits of the forecasts.

The monthly reports of many of the States are model publications of their kind. It is to be hoped that in those States where as yet the more approved methods of publishing meteorological data are not practised, means may be improved and raised to the standard attained where better facilities have been available. Uniformity in size, as far as practicable, and strictness as to tabular data, is very desirable. A daily record of temperature and rainfall for purposes of detailed investigation is most essential, and these should, if possible, form a part of each report.

The following papers were read before the American Forestry Association:—The forests of Alaska, by William H. Dall; the forests of the Shenandoah Valley, their origin and present condition, forestal areas in West Virginia, by Major Jed Hotchkiss; forests in New Jersey, by Prof. John C. Smock; the petrified forests of Arizona, by Horace C. Hovey; the Adirondack Forests, by Verplanck Colvin; the condition of our public timber-lands and forest reservations, by B. E. Fernow; what the people should learn about forestry, by Prof. Selden J. Coffin; tree-planting, by George H. Minier; forest fires in New Jersey, and some notes in methods of protection, by John Gifford; the prevention of forest fires, by General C. C. Andrews; prairie forestry, by Prof. L. H. Pammel; observations on the destructive effects of drying winds and the protection afforded by woodlands and wind breaks, by Prof. F. H. King; Does the rain-gauge settle the problem? by J. O. Barrett; the conservation of soil and water supply of hill countries in cultivated areas, by Thomas J. McKie; black walnut for economic tree-planting, by B. G. Northrup; Western pine timber-lands, by H. C. Putnam; economics in railway ties, by E. E. Russell Tratman; forest fungi and an anthracnose of the poplars, by Prof. Byron D. Halsted; the relation of insects and birds to certain forest conditions, by A. D. Hopkins.

B. E. Fernow called attention to the necessity of following up the policy begun through the efforts of the Association of reserving forest tracts of public timber-land with measures for a rational use of the same. Considerable discussion followed, resulting in the unanimous adoption of the subjoined resolution:

"Resolved, that the American Forestry Association desires to express again emphatically its approval of the efforts of the Public Lands Committee of the House of Representatives, and its chairman, the Hon. Thomas C. McRae, for the enactment of a law providing for the care and protection, not only, but for the rational use also, of the timber and other resources in the forest reservation, and on all public timber-lands. The policy of reserving can hardly be considered an advantage to the forestry interests unless followed up by an intelligent and efficient administration of the reservations, since deprived of the incidental protection. This Association emphatically denies that it advocates in the policy of forest reservations the unintelligent exclusion of large territories from actual use of the resources contained therein; but on the contrary, it reiterates that it conceives that by the reservations made for the purpose of their use—rational use—under restrictions and control which come from private interests in expectation of possible occupancy and uncared for by the rightful owner, the Government, the door is opened to greater destruction and depredation than before. We therefore desire to impress upon our representatives in Congress the urgency of making provisions for the better care of the public timber and other resources, as urged heretofore by this Association."

RECENT EXPLORATION IN BRITISH NEW GUINEA.

AT the ordinary monthly meeting of the Royal Geographical Society of Queensland, on August 20, the President (Mr. J. P. Thomson) read a paper on recent exploration in British New Guinea. The paper was a continuation of one read by the Governor at the Hobart meeting of the Australasian Association for the Advancement of Science in January, 1892. Since then several tracts of new country have been visited, and geographical knowledge of it has been increased by the detailed examination made by Sir William MacGregor of the extensive river systems of the Papuan Gulf, and his more recent exploration of the hitherto unknown parts of the north-east coast. The following extracts from Mr. Thomson's paper are reprinted from the *Brisbane Courier*.

For nearly half-a-century it had been known to geographers that several rivers existed in the neighbourhood of the Papuan Gulf. The Aird, especially, was noticed by the officers of H.M.S. *Fly* some forty-seven years ago, and more recently several channels were opened up by Mr. Theodore Bevan, whose investigations in British New Guinea were chiefly confined to this part of the country. Although these were nothing more than superficial surveys of a mere coastal fringe of the Gulf district they were the means of drawing attention to an exceedingly interesting and important part of the Possession. Here we are made acquainted with a tract of country north of the Fly estuary, cut up by almost bewildering labyrinths of tidal channels that constitute the mouths of several important rivers, which traverse enormous areas of rich agricultural as well as low, swampy, land. To intending settlers in British New Guinea this easily accessible region offers many inducements not readily met with in other parts of the Possession. Ample facilities for inland communication exist in several of the deep-water channels along the coast, while the recently explored Purari River flows through a region possessed of many attractive features of hilly and mountainous country. Along most of the watercourses native villages are thickly scattered, and these are inhabited by numerous tribes of powerful and warlike natives, who on several occasions have opposed the friendly advances of Europeans with formidable hostility. The houses, too, are truly remarkable for their large dimensions and massive architectural structure; dwellings of from 300 ft. to 400 ft. in length and over 100 ft. high being by no means uncommon. Next to the Fly the Purari is the largest river in the Possession. It enters the sea by several large channels. In the inland reaches above tidal influence it traverses some rough, hilly country, flowing almost parallel to and skirting the base of a mountain range 1500 ft. to 2500 ft. above sea level. This river was explored by Sir W. McGregor in January and December 1893. Its average width is about 250 yards. To the north lie a range of mountains 3000 ft. to 4000 ft. high, and southerly the country is greatly broken up by low rugged hills. To the westward the main range is visible at a distance of from fifteen to twenty miles, with its bold serrated perpendicular peaks. There is very little flat land here between the hills and the mountain spurs, although sago palms are more numerous than in some parts of the country lower down the river. The geological formation consists of sandstone associated with nodules of gray limestone. At the Aure junction, some eighty miles from the sea, the Purari receives its first considerable tributary. The width of this branch is from 80 to 100 yards, with a depth of one to two fathoms. Above its junction with the tributary the Purari maintains a general course along the main mountain range, the southern spurs of which it skirts very closely. Here the general character of the country, on the south side of the river, is a continuous succession of low sandstone hills, little more than 800 ft. high. These are rugged and precipitous, covered by dense forest. There are, however, no large trees. There was no appearance of any permanent native occupation in this district, and owing to its rugged nature the country did not seem adapted for European settlement. Several specks of gold were found in the bed of the river, and an important discovery of coal was also made near the island of Abukiru, in the main channel of the Purari River. As it is thought that the presence of coal in this district may greatly influence the future of the country, it has been proposed to arrange for a detailed examination of the locality. The people are bronze coloured, a few being lighter than the Port Moresby natives, and all lighter than those of the Purari delta. West of the Purari delta, between the mouths of the Fly and Aird Rivers, lie three important streams, the Omati, Turama, and Bamu. These traverse enormous areas of low-lying country. Concerning each of these rivers, Mr. Thomson gave some interesting details, the result of Sir William MacGregor's explorations. Continuing, he remarked: "The exploration of the lower Bamu basin, besides throwing a flood of light upon a hitherto unknown part of the country, reveals to us a condition of things not easily understood, and rarely met with in any other district of the Possession. Here no cultivated areas were seen, although the soil is exceedingly rich and abundantly watered. The people appeared to live entirely on sago. Bananas were growing wild amongst the rank forest vegetation, but there were no signs of sugar-cane or sweet potatoes. A fair idea of the richness of the land in this district may be obtained when it is stated that there is nothing to be compared with it in the Fly basin within 400 miles of the sea. It is high and dry and in every respect eminently suitable for extensive and systematic cultivation, there being a much larger area of good available agricultural land than Sir W. MacGregor had 'seen elsewhere in the Possession.' This district could no doubt be thrown open to European settlement without in any way infringing existing native rights." Mr. Thomson then dealt with some of the newly-discovered features on the north-east coast of the possession examined by Sir William MacGregor during the months of February and March last. "Recent detailed examination of some hitherto unexplored parts of the coast-line," said the writer, "has discovered the existence of several navigable streams of considerable importance, while a traverse of the coastal section between Ipote and Dako shows that there are numerous sheltered channels among many coral islands along the shore of the bay. These will be available for trading crafts in all kinds of weather. Passing on from this part of the coast-line, an examination was made of the mouth of a stream slightly north of the Clyde river, within the German territory. From observations of ten pairs of meridian stars the latitude of this stream was found to be 7° 58′ 30″ S., taken at the place where it enters the sea. It is a comparatively small watercourse, forty or fifty yards wide on the lower reaches. The natives here are of a dark bronze colour and quite naked. The hair is worn in ringlets, and removed from the face. Their ornaments consist of Job's tears, earrings of turtle shell, and head ruffs of cassowary feathers. They were armed with spears of palmwood, Gothic shaped shields nearly 3 feet long, and stone clubs. At first they were friendly, but afterwards appeared hostile. The next river to claim attention is called the Mambare. This is simply one of the mouths of a river known as the Clyde, of the Admiralty charts. It lies about two miles within the British territory, and in the lower part traverses some good alluvial land, abounding with remarkably fine fields of sago palms. The river was navigable by the steam launch for the first forty miles, where further progress was impeded by rapids, and some few miles farther the channel is simply a succession of deep pools. Below the rapids some extensive areas of very fine alluvial land were met with, and the forest trees so high that the birds on the upper branches bade defiance to the marksman's firearms. Above the rapids the country was broken, and little agricultural land was to be seen. The district possesses a very fine climate. Sandflies and mosquitoes were entirely absent, and the early morning atmosphere was decidedly cool and bracing. The people have well-cleared and cultivated gardens, in which they plant taro, sugar-cane, edible hibiscus, yams, and bananas; but there were apparently no tobacco, papaya, nor pumpkins. Several villages were located on the banks of the river, some of which are situated in the midst of beautiful groves of cocoanut and betel palms. The only ornamental shrubs met with consisted of a remarkably fine variety of light yellow crotons of great beauty. Ordinary watercresses were met with at one of the villages, but they were seen at no other place on the north-east coast. The men were profusely ornamented with shells, pigs' teeth, Job's tears, cassowary feathers, red seeds, and bones. Some of the women wore a necklace or two, others a narrow matwork belt, but they were clothed with nothing else. In this part of the country they use the password 'Orokaiva,' meaning 'man of peace.' They use an adze of basalt. Their pottery is not well prepared. It is without ornament, thick, and slightly conical in shape. The people seemed to be industrious agriculturists, growing food for the entire population. They possess a great number of canoes. Sir William MacGregor is of opinion that some good agricultural land could be obtained for European settlement without interfering with native occupation, and he further believes that the natives would welcome European settlers who would be prepared to treat them fairly." The next place visited was a small sluggish river, fifty to sixty yards wide, and two fathoms deep, called the Ope or Opera. The position of its mouth was found to be lat. 8° 18′ 16″ S., and long. 148° 11′ 25″ E. It is convenient for watering ships and of value to traders. Several villages were seen in the neighbourhood, and there was evidence of a large population of friendly natives. The men were nude, but the women were covered by a petticoat of native cloth. They were armed with spears and stone clubs, ornamented with wreaths of convolvulus and red hibiscus. They danced, sang, and shouted, but appeared to be very friendly. To the south of this district the Kumusi River flows into Holnicot or Gona Bay, in lat. 8° 28′ S., and long. 148° 16′ E. The mouth is obstructed by a bar, some four feet below the surface. Most of the land on the lower part of this river is low and unfit for European cultivation, although considerable areas of alluvial deposits are occupied by many native gardens, and there are fine fields of sago palms. The highest point reached was about forty-six miles from the sea, by traverse, or lat. 8° 35′ S. and long. 148° 0′ 20″ E., where further progress was barred by rapids. Here the country "was without exception the most attractive" Sir W. MacGregor had "seen in New Guinea." Extensive tracts of splendid alluvial land stretched far and wide along the river valley, covered by forest trees, and to all appearance above the reach of flood. These flats occupy what was formerly the river bed, as indicated by the sandy substratum. Some six miles from the river lay one of the central main mountain ranges, the intervening space being occupied by small mountain streams, numerous rolling wooded hills and flats. At night the air was pure and delightfully cool. Great reluctance was felt at having to leave such a district, where the scenery is of a very fine description. There is apparently a large population here, but the people would no doubt be friendly. When descending the river the steam launch *Ruby* collided with a treacherously concealed snag and foundered. This unfortunate accident compelled the party to travel down an open unprotected coast in the whale and river boats. The Kumusi natives were unusually interesting. They are from a light to a dark bronze colour, not remarkably powerful people, but of fair Papuan physique. Their foreheads are square and rather high, with hazel eyes of fair size, large mouth, small chin, and flat cheeks and chests. The nose resembles that of Port Moresby, only slightly shorter, and the nostrils rather coarser. Both sexes wear cloth of mulberry bark. They use stone clubs, the disc and the pineapple pattern, the palmwood spear with square-shaped sharp end and barbs on one side only, and small Gothic shields, with a few examples of the great shield of Orangerie Bay. The stone clubs and adzes are made of basalt. They have no tobacco growing in their gardens, and were ignorant of its use. Their canoes are similar to those on the Ikore and Mambare Rivers. It was found that a river of considerable size enters the sea at Cape Sudest, but unluckily a bar closes its entrance to navigation. The natives call it Tambokoro. The position of Cape Sudest was determined astronomically, and found to be in lat. 8° 44′ S. and long. 148° 25′ 30″ E. In Dyke Acland Bay three streams were discovered—Kevoto and Umundi Creeks and the Musa River. The mouth of the first of these lies in lat. 9° 4′ 55″ S. and long. 148° 33′ 20″ E. Both creeks are of little importance. The lower part of the Musa River traverses low, swampy country, covered by water when the river is flooded. When ascending this stream the Administrator passed within a few miles of the western peaks of Mount Victory. "It has three principal summits, the western one of which is at present quiescent." Ashy-looking deposits were observed among the rocks on the others, and several large fumeroles, out of which little spiral clouds of smoke were issuing. The highest point reached on the river was about thirty-five miles from the sea in lat. 9° 19′ 10″ S. and long. 148° 53′ 43″ E. Here the stream was about 100 yards broad, three fathoms deep, and the current two to three knots per hour. This place was evidently on the margin of a settled country. The banks of the river were beginning to rise, and the capacity of the channel was about sufficient to carry the water. The forest trees were very large. What the upper portion of the

Musa basin may be is at present unknown, but the lower part appeared to be of little value. Several villages occupy the flooded country on the banks of the river; the houses are built on stilts a few feet above the water. The natives were friendly, but naturally shy and suspicious. They excel in making native cloth, many specimens of which were obtained. Their dead are interred in the villages, the graves being covered with a neatly thatched cage. They use palmwood spears, stone clubs, and adzes of jade. Both sexes wear a native cloth. The men wear the hair long, hanging down the back. They cook their food in clay pots, and eat lime and betel nut. The men were fairly strong and of good physique, but many were suffering from ring-worm and hydrocele. They were anxious to trade, and offered adzes, clay pots, and sago for plane-irons. Some very remarkable pottery was obtained on the north-east coast. The examples are bowl-shaped with outside raised designs, not previously seen in any other part of British New Guinea. Besides these explorations the discovery of Pennegwa Harbour in the extreme north-east of Rossell Island, and a safe anchorage at Mabudaun, which very greatly increases the value of the western portion of the Papuan territory, were described. Mr. Thomson, by means of a map, indicated the territory dealt with in his paper, and at its conclusion a few pictures appropriate to the occasion were thrown on to the screen by Dr. Thomson.

In the course of some remarks, Sir William MacGregor suggested that Mr. Thomson might follow up his paper with another. The one he had just read did not embrace all the latest work that had been done. His (Sir William's) dispatches had not all been printed; in fact, he questioned whether some of them had yet reached his Excellency the Governor. There was a great deal of information which might be included in such a paper. For instance, Mr. De Vis had been examining a number of new and interesting native birds; Baron Von Müller had got a lot of new plants; but perhaps the most interesting, because the most practical, was the work being done by Mr. Jack and Mr. Rands. The geological specimens he had brought from the Purari River indicated a very large district in which there were very rich coal formations. The fossils that were under examination would show very clearly, he thought, the age of the deposit.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—In the lists of lectures announced for the present term, the most noteworthy feature is the removal of the subject of Anthropology from the list of the Faculty of Natural Science, and its insertion under that of Literæ Humaniores. The titles of the Anthropological lectures are "The Intellectual Development of Mankind," by Dr. Tylor; "The Elements of Physical Anthropology," by Prof. A. Thomson; and "Primitive Musical Instruments," by Mr. H. Balfour. There does not appear to be any adequate reason for considering that these subjects should belong to letters rather than to Natural Science, but perhaps it is a sign that a day is approaching when all the subjects of Natural Science will be recognised as forming as much a part of *literæ humaniores*, that is, of indispensable culture, as Philosophy and Ancient History. In the departments of Natural Science there is no change of importance to chronicle. Professors, Lecturers, and Demonstrators are the same as in the past academical year, and the subject-matter of the lectures refers in each case to the examinations in the Honours School of Natural Science. Mr. R. T. Günther is in residence at Magdalen College as Science Tutor, and Mr. W. Garstang is in residence at Lincoln College, and will deliver a course of lectures as Lecturer in Natural Science to the College.

The examination for the Burdett-Coutts Scholarship will be held in the week beginning October 21.

The Vice-Chancellor has appointed Mr. William Holman Hunt the Romanes Lecturer for the year 1895.

A copy of the report of the Minister of Public Instruction in New South Wales, for the year 1893, has reached us. The work of the Technical Education Board for that year was carried on under very different conditions from those of previous years. The scheme for retrenchment of expenditure in the public service led to the reduction of the vote for Technical Education from £49,800 in 1892, to £25,367 in 1893. The field of operations had therefore to be confined within comparatively narrow limits. Only 187 classes were carried on throughout the whole year, and the total number of students was 7096. In addition to the ordinary class work, popular lectures on various subjects were given at different centres throughout the colony. The success of these lectures may be judged from the fact that the Rev. J. Milne Curran lectured in Geology and Mineralogy to audiences aggregating 13,360 persons, or an average of over 300 persons at each lecture.

The *Record of Technical and Secondary Education* completes its third volume with the current number. The journal was only started tentatively, but the experience gained during the last three years has shown that it is wanted, so it will be continued. The present number is full of information of use to promoters of technical education. It includes the reports of the technical instruction committees of Somerset, Hampshire, Isle of Wight, Staffordshire, and Worcestershire. Mr. W. E. Urwick gives a description of primary and secondary education in France, first tracing the progress of an imaginary boy from the primary school upward, and then detailing the means of transition from one school to another, the help offered by the State, and the method of procuring it. So many committees have had to confess that their schemes of agricultural education have, to say the least, been unsuccessful, that an article on the promotion of such instruction in Great Britain should be widely read. It is pointed out that elementary agricultural education must be founded definitely on science, though this may be elementary. The subjects likely to be of most use are chemistry, botany, and zoology. Mathematical subjects should, if only as a matter of education, engage earnest attention, and it is suggested that elementary physics, leading up to the construction of the steam engine, might replace botany or zoology in the curriculum. There must always be stations for field demonstrations and experiments, and this class of work is of a threefold nature. "First, there is the demonstration of the known action of certain elements of plant food when used in manures; it is this which is truly educational. Next comes what may fairly be called experiment, viz. the testing in each locality of the action of different manures on different crops or typical soils. Lastly, there is pure research into the unknown, a matter which can only be successfully carried out at special places, thoroughly well-equipped for this particular purpose. While, however, it is to be hoped that Rothamsted will always form the premier research station for the kingdom, there would seem to be no reason why stations such as that which the Royal Agricultural Society have at Woburn might not, within limits, be multiplied." In addition to the articles already referred to, the *Record* contains an illustrated description of the fine Technical College at Bradford.

The "Guide to Technical and Commercial Education," first issued by the Dundee and District Association for the Promotion of Technical and Commercial Education some five years ago, and the third edition of which has recently been published, has done good service. The object of the guide was to indicate the lines along which apprentices might with advantage be urged to a systematic continuance of their education in subjects bearing on their particular occupations. In point of fact, the aim of the Committee was to do for the apprentice architect, engineer, mechanic, or other craftsman, in the Technical School, what long ago in the Universities has been done for the professions by the institution of definite lines of study. Several Technical Instruction Committees have drawn up similar courses of study to be followed by young artisans in order to become efficient workmen; and when such schemes are properly drafted, they serve a very useful purpose.

SCIENTIFIC SERIALS

Quarterly Journal of Microscopical Science, vol. xxxvi. part 4, August.—In the first of a series of "Studies on the Nervous System of Crustacea," Mr. Edgar J. Allen gives the results of a careful investigation of the structure of the brain and ganglionic chain in lobster embryos. By the employment of Ehrlich's methylene blue method he has been able to demonstrate the course of the constituent nerve-fibres, both co-ordinating, motor, and sensory, with remarkable success. The author's observations agree with those of Retzius, Kölliker, and other recent investigators, as to the absence of any form of anastomosis between the fibres of different elements. Nervous discharges must, however, pass from one element to another by means of the finer terminal fibrils, which are shown to be frequently arranged in the form of distinct tufts, having a constant position relative to each other. On this account the author hazards the suggestion "that the nervous energy resembles a static electrical charge, in the fact that the discharge takes place most readily through points," the opposing tufts of fibrils of different elements being thus comparable to the "brushes" of an electrical machine. In the second and third of his "Studies," Mr. Allen deals with the Stomatogastric System of *Astacus* and *Homarus*, with the Beading of Nerve-fibres, and with End Swellings.—Other papers in the same number are by Mr. E. A. Andrews, on some abnormal annelids, and Mr. W. E. Collinge, on the sensory canal system of Ganoids. All these papers are admirably illustrated.

American Meteorological Journal, September.—On cloud formation, by Prof. W. von Bezold. This is a translation, by L. A. Bauer, of an address delivered in the "Urania" of Berlin, November 29, 1893, and published in *Himmel und Erde*, vol. vi. No. 5. (We gave a brief notice of this valuable paper in vol. xlix. p. 508.) Prof. von Bezold's explanations of the formation of fogs and clouds are exceedingly interesting and instructive, and the translation into English will be of great use to many readers who may be unacquainted with German. Several of the cloud views have been made in Berlin expressly for this article.—Summer hot winds on the Great Plains, by J. M. Cline, M.D. This paper has been reprinted from the *Bulletin of the Philosophical Society of Washington*, vol. xii. 1894, and contains an account of the hot winds observed from 1874 to 1892, and of the general meteorological conditions prevailing at the time of their occurrence, together with a description of the general characteristics of those hot winds, and conclusions as to their causes.—The meteorological services of South America, by A. L. Rotch. The countries in which meteorological observatories and central stations exist are Peru, Chile, Argentine Republic, Uruguay, and Brazil. Those dealt with in this article are Peru, in which is situated the observatory of *El Misti*, the highest station in the world, and Chile, of which the National Observatory is at Santiago, and was founded by the United States Transit of Venus Expedition in 1848.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 8.—M. Lœwy in the chair.—On the eccentricity of the orbit of Jupiter's fifth satellite, by M. F. Tisserand. If a be the great semi-axis, e the eccentricity, and ϖ_0 the longitude of perijove at a certain epoch (October 28, 1892), we have, as a first approximation,

$$a = 47''\cdot906,\ e = 0\cdot0073,\ \varpi_0 = -14°.$$

—On the groups of transformations of differential linear equations, by M. Émile Picard.—Theory of flow on a weir without lateral contraction, when the bending liquid sheet is either depressed, submerged below, or adherent to the weir, by M. J. Boussinesq.—On the propagation of electromagnetic waves in ice, and on the dielectric power of this substance, by M. R. Blondlot (see Notes, p. 604).—Mean magnetism of the globe and "isanomales" of terrestrial magnetism, by M. Alexis de Tillo. The tables given show the mean value for the magnetic elements for parallels at 10° intervals for the years 1829, 1842, 1880, 1885.—M. Haton de la Goupillière informs the Academy that M. Cotteau has left his fine collection of fossil Echinoderms to the National School of Mines. This collection, combined with the Michelin collection, already at the School of Mines, will probably be the most complete of its kind.—On the dielectric power of ice, by M. A. Pérot. On recalculation of the results published on June 27, 1892, K assumes the value 2·04.—A study of the latent heats of vaporisation of the saturated alcohols of the fatty series, by M. W. Louguinine. The latent heats of vaporisation obtained are as follows: For ethyl alcohol, mean of eleven experiments, 201·42 cal.; Ramsay and Young's value, 206.4 cal., calculated by means of the formula

$$L = (s_1 - s_2)\frac{t}{I} \cdot \frac{dp}{dt},$$

where t = absolute temperature and I is the mechanical equivalent of heat, probably differs from the experimental value owing to accumulated errors of data entering into their formula.

Normal propyl alcohol, L = (1) 164·07 cal.; (2) 163·19 cal.
Isopropyl alcohol (Sp. Ht. assumed same as N. P. Alcohol), L = 159·72 cal.
Normal butyl alcohol, L = 138·18 cal.
Isobutyl alcohol (Sp. Ht. of normal alcohol used), L = 136·16 cal.
Fermentation amyl alcohol, L = 118·15 cal.
Dimethylethylcarbinol (Sp. Ht. assumed same as amyl alcohol), L = 110·37 cal.

All determinations were made at pressures between 745 and 755 mm.—On a particular case of the action of alkalies on glucose, by M. Fernand Gaud. The reaction of the alkali on glucose has been followed by means of different metallic oxides, capable of precipitating each of the products in turn, step by step.—On the production of gaseous formaldehyde for purposes of disinfection, by MM. R. Cambier and A. Brochet.—Manufacture of alumina from clays, by M. Joseph Heibling.—On the germination of oleaginous grains, by M. Leclerc du Sablon.—Experiments on the eggs of the mulberry silkworm, an annual race, by M. Victor Rollat. It is found that hatching may be produced at any desired time by submitting the eggs to the action of compressed air at the pressure of 6 to 8 atmospheres for a fortnight—M. J. Posno describes, in a note, the results obtained by a process of distillation of house refuse.—M. F. Larroque reports the ravages produced by anthrax in the higher pastures of the Pyrenees.

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